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## EDITORIAL NOTES.

### Sharing the Burden—Sliding-Scale Gas Companies.

THE whole nation is involved in a period of unprecedented financial burden, the fullness of which was not by any means disclosed by the budget speech last Tuesday of the Chancellor of the Exchequer, in which he outlined his plans for increased taxation with the view of meeting part of the enormous expenditure occasioned by the war. Heavy as the burden is known to be, heavier still as we anticipate with certainty it will be, the nation will bear it all with the philosophic courage and patience which are essential to the effective consummation of such a cause as that which we, with our Allies, have in hand. The scheme for the reinforcement of the national revenue which Mr. M'Kenna put before the country is generally regarded as being quite equitably based. But, of course, we cannot expect such a far-reaching scheme, although it is spoken of as being equitable, to be perfect under all conditions of the incidence of its various elements. We must swallow the imperfections of incidence, seeing that it is impossible to legislate for each and every condition in a matter of this kind. However, by way of example, we cannot see that the heavy income-tax is altogether quite fair in respect of dividends statutorily regulated, through the operation of a sliding-scale, in relation to the price of gas There is to be an addition of 40 per cent. to the income-tax; but the addition is only to be 20 per cent. for the remainder of this year. As a matter of fact, this is not so heavy as was freely expected in view of the current enormous expenditure of the country. The addition appears to mean that the 20 per cent. in the current year will increase the tax by $3\frac{3}{5}$d. in the pound on earned incomes up to £1000, and 6d. on unearned incomes—making the total rate in the pound for 1915-16 respectively 1s. $9\frac{3}{5}$d. and 3s.; while for 1916-17 the respective rates will, under the 40 per cent. increase, be 2s. $1\frac{1}{5}$d. and 3s. 6d.

Now in respect of unearned incomes, the sliding-scale of price and dividend in connection with gas supply never contemplated such an inordinate condition of things as that which now exists. The sliding-scale is an admirable institution in normal times; but in such days as these, the inflexible operation of the sliding-scale must bear very hardly, especially upon investors of small capital power, who are further hit by the exemption being reduced from £160 to £130, while the maximum abatement is brought down to £120. Gas companies under the sliding-scale are quite different from industrial enterprises that can shift the burden of additional expense entirely on the consumers, so maintaining dividends, and thus putting the shareholders in the position to the more cheerfully pay a heavy tax. But here we have shareholders of gas undertakings seriously injured by a concatenation of circumstances from which they have no means of escape or relief owing to the useful governing laws of normal times, but grievously hard laws in a period such as this, when their need is that the rates of dividend shall be as little affected as possible. Dating especially from the national coal strike of 1912, the price of coal has been mounting up, and superimposed upon this comes the extra price produced by war conditions and opportunists. Reluctantly, most boards of directors have had to put up the price of gas to figures that transfer us to long past days for the local equivalents; and down have fallen dividends to figures of serious nature to people of small incomes and dependant largely, if not wholly, upon their dividends from gas securities. These happenings have brought down the market values of gas shares and stocks to prices that have not had precedent since the slump in the early eighties when the bogey of electric light frightened gas shareholders more than Zeppelin raids do the people of London to-day. From the exiguous dividends there has to be deducted the heavy income-tax. There are dividends to-day that are down to a few shillings over 4 per cent., and after paying income-tax these were last half year returning to the investor under 4 per cent. The investors will be worse off this half year, and worse still in the succeeding one, unless something can be done to give them relief by reducing the price of gas. Truly investors in gas undertakings where there have been heavy advances in the price of gas, are not only sharing the burden, but they are feeling acutely the burden of sharing in a sense that does not obtain in any other industry or business. Though fair and beneficial in ordinary times, the extent of the deprivation of income through the war, from which condition there is no provision whatever for relief by a suspension or partial suspension of the sliding-scale, is not altogether just in comparison with other enterprises working under no restriction as to dividend in relation to the price charged. And the end clearly is not yet. It is true that the Chancellor is contemplating reducing cases of hardship by proposing that, where a person's income is less by one-fifth what it was, he or she shall be relieved of the whole of the 40 per cent. increase; and where the deficiency does not amount to one-fifth, but is more than 10 per cent., there shall be allowance of a proportionate amount of additional duty. But people of small incomes—and we have a large number of them as investors in the gas industry—do not like applying to the clogged, slow-moving machinery provided for considering appeals in respect of income-tax. It is a terrible ordeal; and people often prefer to suffer an injustice in this connection rather than try to obtain redress.

Regarding the tax on war profits, we are confident it will be waste of time applying to the majority of gas undertakings for any return as to excess of profits that has obtained during the war period. What with higher prices of raw materials and increased outlay in other directions, reduced public and shop lighting, domestic economy, and unsaleable pitch, even with increased prices for gas and lower dividends, there are gas undertakings that have been barely able to make both ends meet. There are, however, some gas undertakings whose profits (not dividends) will exceed those on the income-tax assessment for 1914; and, as the tax of 50 per cent. of the excess above £100 is to apply to all trades and businesses, there is another proposal here that, if we appreciate the position correctly, will under the peculiar circumstances operate unfairly. The income-tax assessment for 1914, in the case of gas undertakings, applies to a period of dear coal—a period, too, during part of which coke was a drug in the market, and sulphate of ammonia dropped largely in value. Profits were slender, balances forward were depleted, reserve funds were eaten into—all in the hope that better times would come, and to save, if possible, placing on the consumers the burden of an increase of price. Because of these considerate doings, and because, on raising the price of gas through the compulsion wrought by the war, profits now are in excess of the income-tax assessment for 1914 (though far from being up to the normal), are the gas undertakings to have taken from them 50 per cent. of the excess profits above those of 1914? The coalowners and contractors and shipowners are largely responsible for the condition in which the gas industry finds itself to-day. They will have to pay their share of excess profits. It would serve some of them right if they had to do as labour suggests, pay the full 100 per cent. (or at least 80 per cent.) of the excess. Partially, the position of the gas supply industry is also that of some concerns manufacturing gas plant and appliances; and they could adopt the same argument we have applied to the former in respect of excess profits. Perhaps, however, there will be power of appeal under special circumstances; seeing that a special tribunal (may be it is only to deal with works producing munitions of war) is to be appointed in order to decide upon a fair "datum 'line,'" in all the circumstances. This tribunal, if and when it is appointed, will find plenty of work to engage its attention.

With the lowering of the exemption limit, the inclusion

of wage earners in income-tax payment, and the collection of income-tax quarterly from all employees, there is a large amount of approval—with, naturally, exceptions among the persons affected. It can hardly be expected that they would all suddenly fall into line in agreeing that it is right they should share in the financial responsibilities of the present crisis. The Government, too, have taken a correct step in determining that payment of income-tax by wage earners and its collection shall be entirely a matter between the former and the latter. This is better than putting upon employers the responsibility of collecting the tax by deduction from wages. Such a course would only have raised latent animosities and produced no end of trouble. Being a matter between State and worker, if the latter thinks he is not called upon, as a British subject, to contribute to the expanding expenses of the country, he must settle the matter with the State.

It is proposed that the Road Board shall suspend operations, and that the income derived from motor spirit and motor car licence duties shall be retained by the Exchequer, and that an additional 3d. per gallon duty shall be put on motor spirit. The former proposal means that the comparatively small demand for tar that there has been this year for road purposes will be further diminished. We are pleased to see that certain imports are to be taxed; but are not altogether sure that in the best interests of trading at home (from which so much of the country's revenue is derived) the changes that are proposed in the postal, telegraph, and telephone rates—which will probably come into operation on Nov. 1—are correct. But our view has not the support of the knowledge possessed by the inquiries of the Committee on Retrenchment in Public Expenditure. Of course, no one can defend the conduct of a public "trading" department (if so the Post Office can be termed) on a non-paying basis, unless thereby the general interests of the country are promoted. Probably good argument can be advanced both ways here. But our principal concern in connection with the changed fiscal conditions of the country, and the increase of taxation, is the position of the sliding-scale gas companies.

## Organization of Scientific and Technical Bodies.

THE charge of deficiency in organization in this country is freely admitted to be true. It applies to our scientific and technical resources as well as to other things. The scientific and technical institutions are all so hedged about and individualized that one cannot detect in them any recognition of the fact that they are components of a great system—components which, if they are not doing so, should be ever and definitely aiming at contributing to the general advance and efficiency, both alone and by co-operation with other components. Because there is so much indefiniteness and want of co-ordination of work, so much division, and so little intercommunication, there is not, in connection with the scientific and technical institutions, that degree of efficiency and aggregate result we have a right to expect from their expenditure of time, energy, and money. The accusation as to the want of systematic organization and co-ordination of work has come from various quarters; and several more or less crude notions are abroad as to how improvement could be effected. Some suggest—as has been proposed time after time—individual improvement by internal exertion; others urge that the greatest advance in individual improvement and the production of the best results to the common good could be achieved by the closer union of the various organizations, and a mapping-out of work, so that there is less duplication, and more positive aim, and thus greater economy and efficiency. With such a union, upon the work of each body the advice and practical aid of the men of the learned societies with special talents in particular directions could be brought to bear.

Often the Institution of Gas Engineers has been pointed to as representative of a technical body which seems incapable of getting far out of its ancient rut, and which gives the minimum of result. It is an organization meeting once a year only, and largely dormant during the rest of the twelve months, except when the Council meet, or interest is taken in some topic of current importance to the industry. No one could have the impertinence to hold up the Institution as the standard of what a technical organization should be. It is representative only of the gas profession; and not of the gas industry. Even the technical side is only imperfectly represented by it, owing to the exclusion of the technical men concerned in the design and manufacture of gas plant and appliances. Because of its exclusiveness, the Institution has kept a large amount of technical ability from its doors which would have done much to have raised the efficiency of the body and the value of its technical production. Some of the learned societies are awaking to their deficiencies in organization and result; whether the Institution will do so is doubtful, having regard to the past. Anyway, introspection ought to awaken as to shortcomings, and produce some sense of shame as to poverty of result. The President of the British Association—Professor Schuster—openly confessed, in his recent address, that, while the Association has done good, and rendered excellent national service in a spasmodic sort of way, there has been a looseness and an absence of settled plan about its operations. Current conditions, however, induced him to ask whether the time has not arrived when it may be possible to secure not only a greater continuity of the work of the Association, but its better co-ordination. If the present conditions do not compel every scientific and technical institution to see that it is incumbent upon it to adapt itself to the needs of the times (which means more efficient, and the promotion of larger, service), then the salient lesson of the war will have failed—the lesson that the successful resistance of the enemy so far has been due to complete organization and working for progressive efficiency, while our attempts at breaking down the resistance have been hindered and prolonged indefinitely by our deficiency in organization, though not fortunately the ability to organize.

There is the larger question than this resolve of the British Association or any other scientific or technical institution to mend its ways, and revise its plans so as to render more efficient service in its particular sphere and to the nation generally. This larger question is the co-operation between the many existing scientific and technical bodies, so as to organize and co-ordinate work in a manner that shall yield more profitably. Such a scheme, if properly organized and carried out, should be fruitful. But we cannot help feeling that the difficulties would be great, and as yet the idea is rather vague. For one thing, it does not appear to us that there is any existing organization that is competent to take the headship in this matter, through the lack of a sufficiently broad composition. A tendency exists in some quarters to select the Royal Society as the "top dog" in any scheme to link-up the work of the scientific and technical bodies. Sir Thomas Holland, presiding the other day at a meeting of delegates from corresponding bodies of the British Association, pointed to the voluntary formation of innumerable societies with overlapping functions, yet no cohesion, and no apparent common aim—societies which in a limited way work out their own lives and course of action, without any consideration as to whether or not they have within their ranks all that would be helpful to them, and all the talent that is required to attain a high efficiency. The result of an ungoverned individuality, Sir Thomas holds in effect, represents a loss of power, due to an undesirable number of wheels in our machine, and an unnecessary duplication of effort owing to want of method in organization. He is one of those who suggest that co-ordination should be effected under the Royal Society, and that State aid should be rendered. The Board of Education scheme for the promotion of systematic scientific and industrial research [*ante*, pp. 232, 255], under a Research Committee, with an Advisory Council composed of men of special qualification, also contemplates that the Advisory Committee shall act with (named) the Royal Society and (unnamed) other scientific and technical bodies in formulating work, and in obviating unprofitable overlapping between institutions and persons engaged in research. This all shows a decidedly growing view that something could, and should, be done to bring about the better organization of our scientific and technical institutions, so as to secure larger and more valuable product. A greater interlinking of work was also a point in Professor Bone's masterly address to Section B of the British Association, as published and commented upon in the "JOURNAL" a fortnight ago. He indicated how much the country is losing by the uneconomical use to which fuel is largely put to-day, and urged greater united activity between engineers, chemists, and physicists in suppressing the waste that is proceeding. In this one economic subject, there are problems incalculable for solution, if there were better organization of scientists and technicians.

Admitting that the individual organizations require to set their houses in order, and to better organize so as to attain

greater economy and efficiency; admitting, too, that collective organization of the scientific and technical units under a central and principal body would be of advantage to efficiency and progress—the question arises, Is the Royal Society the best body for this purpose? While holding the members of the Society in the highest respect, we have our doubts. The members of the Society are the optimates of the scientific world; but they are not, taken as a whole, in the necessary direct touch with industry to enable them to render the most practical aid by being placed in chief position in any organization of, and co-operative effort by, the scientific and technical institutions. A specially constituted central authority with representation drawn from all quarters would, in our opinion, be much more effective and efficient—such a central organization, State-aided, as Mr. Charles Carpenter, D.Sc., adumbrated in his paper before the Society of Chemical Industry in July last [*ante*, pp. 115, 130], which central authority would keep in touch with technical progress and requirements through the media of the associated institutes throughout the land. Under this scheme, each industry would have its own institute of technology not only to provide training for workers, but with fully equipped resources, so that problems of all kinds in connection with the industry could be submitted to the specialized establishments for research. The organizations associated with each industry have special work to do; and if the now current ideas germinate, and a scheme of collective organization and co-ordination of work be adopted, nothing whatever must be done to destroy the advantages of individuality and specialization. Whatever the plans, they must be initially directed to the development of the existing scientific and technical bodies and their work. To this end—if the greatest good is to be attained—every care would have to be exercised in selecting the central body; for its ability to supervise and direct would depend upon the breadth of competence in its composition.

## Fixing a Gas-Standard.

Of the group of papers of which abstracts are published by us to-day, and which are occupying the attention of the members attending the International Gas Congress at San Francisco, we may easily award the palm for current interest and value to the one prepared by Mr. R. S. M'Bride, Associate Chemist, Bureau of Standards, Washington. The subject of the paper is "Substituting Heating Value for "Candle Power as a Standard." The author discusses frankly and freely the considerations he submits should be taken into account in deciding upon the standard and the test to be adopted in connection with gas supply to-day. In our opinion, he goes unnecessarily far in bringing within the bounds of essential consideration some of the minor factors; but, on the other hand, we feel persuaded, by the character of his contribution, that Mr. M'Bride has not so engirded himself with considerations immediate and remote that his mind is closed to conviction that the considerations he advances are, taken as a whole, really a counsel of perfection, and somewhat beyond the needs.

When among the fundamental principles relating to the fixing of the standard of quality, Mr. M'Bride lays it down that it must be a real measure of the usefulness of the gas for the principal purposes to which it is put, he cannot do other than conclude that calorific value is the only possible standard, and that the illuminating power one must go. Having come to this conclusion, the more troublesome matter is to decide what shall be the numerical extent of the standard in British thermal units. We are afraid there must be confession that in this matter (though there is not now really much about which to complain) our British legislators have laid down the standard here in a somewhat arbitrary fashion; the line taken being the crude one of determining what has been the approximate calorific power of gas supplied in two or three representative districts under the illuminating power standard of 14 candles. The question as to the numerical standard being fixed with an eye to the community of interest as between consumers and suppliers, or any economic considerations which would be to the advantage of consumers and undertaking—such as the calorific quality of the gas to be obtained under the local circumstances of coal supply and plant—have never entered the heads of our legislators. Yet (we repeat) there is fortunately little about which to complain in respect of the calorific standard now commonly applied by Parliament. It is only right that the standard should be such as to permit choice of the most economical plant and the use of the most economical of the nearest available coals, and so as to admit of the making of the quality of coke, &c., best suited to the local markets. But we do not think anyone could go so far as to consider the depreciated value of plant as a factor in influencing gas quality requirements; it is a duty on gas suppliers to maintain the efficiency of their plant so as to produce the statutory quality. If temperature, pressure, and friction losses were all taken into account, the labour of calorific standard-fixing would be a never-ending one.

Further, it certainly does not appear to us, under the conditions and experiences here, that it is necessary to fix any standard to apply to gas reaching the consumers' premises, because this would necessitate considerable labour in testing. Mr. M'Bride holds that, while tests made at the gas-works are of value, they do not serve to detect deficiency in quality resulting from loss of heating value in the course of supply, because of improper operation during the condensing of the gas. Earlier in the paper, he says that it has been found that changes in heating value of the gas which occur are a much smaller percentage of the total than the loss in candle power that happens simultaneously. This shows that the constituents contributing largely to calorific power have a greater stability than the hydrocarbons contributing largely to illuminating power. This being so, if tests are made on each of the trunk mains leading from a works, there is quite sufficient assurance as to the requisite calorific value reaching the consumers. But Mr. M'Bride does not appear to suggest continuous tests at distant parts of the district of supply, but only tests from "time to time" in order to determine whether or not the calorific quality of the gas has deteriorated unduly *en route* to the consumers. There can be little value in this, seeing that all the evidence points to slight deterioration; and, if there were unusual deterioration, it might not happen to be at the times when the intermittent tests were made.

We may take an early opportunity of referring to two or three other aspects of this interesting paper.

## Gas Heating and Air Pollution.

A short time since we were favoured with a copy of the first report of the City of Manchester Air Pollution Advisory Board, consisting of members of the Corporation Committees and gentlemen associated with local scientific and technical bodies, all of whom are working in collaboration with the Sanitary Committee of the Corporation. The object of the Board is, by propaganda and the results of investigation, to make a healthy impression on the smoke trouble; and this is an object of economic and health promoting importance. The report satisfies us that the Board are working on beneficial lines; and we fully recognize the value of what is being done by them not only in relation to Manchester, but because the example they are setting will, in all likelihood, be copied by other prominent cities and towns. But there is one warning we would give the Board. It is that they must not imagine, so far as the use of gas is concerned both in domestic and industrial operations, that there has been no prior investigation. As a matter of fact, there has been so much good research work that there is a fairly extensive knowledge available as to the scientific aspects of the employment of gaseous fuel. Seeing that gas cooking stoves, gas-fires, gas apparatus for providing hot water, gas-heated furnaces, and other appliances in use in the United Kingdom total to millions, and that improvement in these various applications to domestic and industrial purposes has been produced by scientific research and practical experience, it would be well for the Board to investigate first what has been done in these directions before setting out to traverse anew the long road of past competent and unimpeachable research.

Prompting this warning are the remarks that Mr. E. D. Simon, the Chairman of the Manchester Air Pollution Advisory Board, made [*ante*, p. 572] when air pollution was under discussion at the meeting of Section B of the British Association, over which section fortunately Professor W. A. Bone, D.Sc., F.R.S., was presiding. Among the investigations the Board are making are as to improved means for reducing both factory smoke and domestic smoke. It is a thousand pities that whatever work is needed in this direction is not undertaken nationally—say, through the Departmental Committee on Smoke Prevention—instead of locally, so as to prevent all that repetition work which comes from the appointment of many bodies to cover the same objects, so producing uneconomy, inefficiency, and complication. It

was against this sort of thing that there was strong protest in some of the principal addresses delivered during the meeting of the Association. However, this is a matter that is coming to the front in connection with the new-born recognition of the need for better organization of our national scientific and technical resources. Mr. Simon's remarks were directed chiefly to that most difficult of all problems in connection with the smoke trouble—domestic heating. He regards as a hopeful line of work (as many have done before him, only to be disappointed by the result and the financial loss) the promotion of the use of part-carbonized coal, from which valuable products and a considerable proportion of the volatile matter have been removed; and there is the adaptation, too, of the open grate for burning gas coke. But he admits that most important of all is the use of gas-fires and other gas-heated appliances.

This admission brings us to the point where, as Chairman of the Air Pollution Advisory Board, Mr. Simon indicates that he is not sufficiently acquainted with the work that has been done with gas-fires and other gas-heated appliances, and with what to those living outside the industry is the amazing popularity which such fires and appliances in their modern state have already attained. He asserts that much remains to be done before gas-fires are procurable which will give out radiant and convected heat in the best proportions, which will not allow leakage of "gas" into the rooms where they are being used, and which will afford the right amount of draught up the chimney. It must be confessed that we are at a total loss to understand what Mr. Simon means by the assertion. Tests made at the Leeds University and elsewhere show conclusively that the proportions of radiant and convected heat, and of the waste heat which promotes chimney up-draught and ventilation, are such that any variation that may be made in the future will be on a relatively small scale compared with what has been done in the past. This was indicated by Mr. H. James Yates's remarks [*ante*, p. 586] on the same occasion, although there was no admission by him, nor is there by us, that the end of gas-fire advance has already been realized. As to the leakage of "gas" (it is assumed that products of combustion are intended), the "Lancet" laboratory tests show that escaping products of combustion are things of the past with modern types of fires of recognized makers.

There is another point in relation to which Mr. Simon, as Chairman of the Manchester Advisory Board, does not appear to have been sufficiently informed. He states that promising attempts are being made to devise a standard method of measuring the total radiant heat of a fire. A standard method is already in existence; and what has been done has been to propose what are declared to be improvements upon this standard method. Of course, it may be that the Board are working independently, and are hoping to propose something off their own bat; but this can hardly be the case. However, Mr. Simon is hopeful that, with a standard system for testing radiant heat efficiency, the Board will be able to give independent and authoritative advice as to the best types of heating appliances to instal under any given conditions, having regard to questions of gas heating and ventilating effect. This can now be done if the Board chose to take up such work; but it would be rather a big undertaking for voluntary effort.

However, a valuable line of work which the Board could readily enter upon would be to try to bring the Manchester Corporation to their senses in regard to gas profit appropriations in relief of the rates. Mr. Yates showed that, by the improvements in gas-heating appliances which have been made, the solution of the problem of domestic heating is within measurable distance. What stands between the complete conversion of the domestic hearth from coal to gaseous fuel? There is nothing to-day, save custom and the cost of gas. We are in difficult times now in regard to the price of coal; and the cost of gas is temporarily increased. But in normal times gas should be sold as low as possible; and nothing should be done in abnormal times to exact from the consumers of municipally produced gas, profits beyond what are necessary for the purposes of the undertaking in order that large sums may be devoted to the relief of the rates. To at any time take profits from gas consumers so that the rates may be relieved, is an injustice; to take profits when things are in the extraordinary condition of the present, is a gross injustice. Professor Bone did not mince words in characterizing what the Manchester Corporation are doing. It is a "pernicious and senseless" custom, he said, to relieve the "rates out of the profits." Mr. J. G. Newbigging, in a paper he read before Section G [*ante*, p. 588], said he thought the injurious effect of the policy is not fully realized. It is cheap gas that is wanted for the highly efficient fires the makers have produced. It is an absurd and uneconomical thing to take £50,000 per annum from the gas consumers to relieve the rates, while an immeasurably greater injury is being done to property and health by smoke, and 10 per cent. of the sunlight is being screened from the people of Manchester by the same cause. The balance of this particular account is certainly on the wrong side. Cheaper gas would really mean a larger adoption of gas-fires; the larger the adoption of gas-fires, the smaller the volume of smoke sent into the atmosphere.

## Efficient Service in Production

The British gas industry feels honoured that certain of its representative men were invited to prepare for, and contribute to, the Gas Congress in San Francisco papers delineating present practices in the manufacture and distribution of gas by the gas undertakings in this country. Abstracts of their contributions are to hand; but it will be roundly regretted that the fore-part of manufacture is unrepresented by them. The primary cause for this is the lamented death of Mr. Edward Allen. Mr. John Bond is also under obligation to contribute to this section; but an abstract of his part of the work is not included. We hope this merely means that there has been some delay in completing the contribution. Dr. W. B. Davidson, however, describes British practice in the condensing, washing, and scrubbing of gas. There is not much in regard to developments in condensing for him to relate; and in washing and scrubbing, though there have been advances, there is really no recent innovation to describe that has commanded any large adoption. The practices are now fairly common and general. The purification of gas is treated by Mr. J. Ferguson Bell; and he has a very good tale to narrate as to the practices that represent low cost purification in this country, and, not only so, a feature is the high sulphur compounds purification efficiency of the catalytic method perfected at the works of the South Metropolitan Gas Company.

## And Distribution and Supply.

Carrying forward the tale to the distribution system, Mr. Walter Hole tells of the changes in distribution that have been necessitated by extended areas and the growth of application of gas in industries and in the home. The only method that presents itself to his mind for meeting the varied demands with the utmost efficiency is to maintain the highest requisite pressure, and to govern-down on the consumers' services. To resist the tendency to increased leakage under the pressure necessities of the time, it is imperative that the distribution plant should be systematically improved and made gas tight. He recognizes the considerable capital expenditure that would be needed to provide ideal conditions in respect of individual governing; but, if the industry is to make the best of itself, we have to bow to the inevitable in regard to new conditions. There are introduced, by the way, several personal experiences regarding individual points. High-pressure supply has now acquired an indispensable place in our practices, and has enabled progress to be made that would otherwise have been impossible. All this indicates the necessity of working to provide adequate supply to the whole body of the consumers. Mr. F. W. Goodenough, in a succeeding contribution, on practices in the sale of gas, puts adequate and constant supply forward as the premier essential, the second being efficient appliances, and the third their maintenance in a good state of efficiency. Much else makes up a good story; but from condensing to sale, there is one objective, and that is "Efficient Service."

## Mr. Newbigging—Revolutionist.

Adverting to our editorial of last week with this heading, what we then anticipated has happened. "Meteor" of the "Electrical Times" finds that Mr. Newbigging "throws up the sponge on behalf of gas as a lighting agent." "Gas is compelled not only to yield ground to electricity, but also to shorten its line of trenches." Mr. Newbigging would like to see "the light business handed over to the Electricity Department, leaving the Gas Department a monopoly of gaseous fuel supply." "Meteor,"

however, doubts whether electricity is "in the mood for any bargaining. Nothing less than victory all along the line will satisfy those who have for three decades fought an uphill fight, and have never hitherto received quarter or even the courtesies of civilized warfare from the enemy. There are such things as electric-fires and electric-cookers. They will do for the gas-stove what the motor has done to the gas-engine, and the electric-lamp is doing to the gas-mantle." So speaks the prophet, who has prophesied often with, for him, painfully bad luck. Under the shelter of the wing of Mr. Newbigging, he forgets that the gas industry is a very large thing, and his protector only a unit of its extensive *personnel*. The three decades of uphill fighting of the electricity industry show the tremendous difficulties of the problems it has had to face; and they are not all solved yet. The "courtesies of civilized warfare" are well exemplified by the defamation by the electricity industry of gas owing to its strength and the slowness of the advance made by electricity in general supply. The latter part of the quotation consists of empty words, which are easily crushed by the facts supplied by the Board of Trade returns and the demonstrable capacities and economies of gas appliances. The gas industry is quite prepared to fight without making any compact as to the limitations of business operations. Mr. Newbigging (who was, in his paper, speaking for himself, and not for the gas industry) has sent for publication a letter on the subject of his attitude. It appears to-day in our "Correspondence" columns.

### Retrenchment.

The Committee on Retrenchment in Public Expenditure (who have for their Chairman Mr. R. M'Kenna) some days ago issued a first report, certain conclusions of which were reflected in last week's War Budget. With the object of ascertaining what savings could, in view of the necessities created by the war, be effected in the Civil Departments without detriment to the interests of the State, the Committee have already taken evidence from a number of the large Departments, including the Post Office, and from representatives of the London County Council. Taking the Post Office first, as being the Department financial alterations in which may be expected to most widely affect the public, the Committee make recommendations which have to a large extent been adopted in the Budget, and are already being discussed throughout the country. In another direction, the Committee have been much impressed by the expenditure upon Blue-Books, Parliamentary Returns, and certain other publications. It seems that the cost of printing alone amounts to about £40,000 a year for papers presented to Parliament [excluding the various departmental publications]; and it can be easily understood that "the cost of collecting and compiling the materials must be very much larger." The sales are admitted to be usually negligible; and the Committee feel that in some cases the original demand for the information supplied has now ceased, and the publications could be dispensed with. They recommend therefore that Government Departments should carefully review all the reports returns, and publications hitherto presented to Parliament or published, with a view to the permanent discontinuance of any which are no longer of sufficient importance to justify the money spent on compilation and printing; to the temporary discontinuance for the period of the war of any which, though necessary in normal times, can be dispensed with temporarily without grave risk or inconvenience; and to the permanent curtailment of the length of all publications by excluding those portions which are not absolutely necessary, or which are required for departmental use only, and need not therefore be printed. It will be interesting to have a list of the publications which it may be decided to deal with in any of these ways. Economy in coal and lights by the various departments in the coming winter is enjoined; and the Committee also make reference to the work of the Road Board, the expenditure of local authorities, and various other matters.

### How to Reduce Gas Bills.

Occasionally hints which are more mischievous than practical appear in the Daily Press, advising gas consumers how they may save money on their gas bills. Such an article was published a few days since in the "Evening News." It purported to have been written by a gas user. His expedient for saving from 5s. to 15s. per gas bill is simple but misleading, and therefore is not ingenious. It is suggested that the meter-cock handle should be turned until it is in the position in which the passing supply of gas will keep the burners fully alight. This position, the writer says, is generally midway between 45° and 60° to the position of the meter-cock when closed. He also suggests the alteration of the stop-pin in the barrel of the gas-tap, so that this can never be turned more than three-quarters on, this being declared to be about correct if the meter-tap is rightly positioned. But a sharp eye has to be kept on the meter-inspector. He seems to be an individual who looks after his master's business, and not the consumers' interests. After he has called, and done his nefarious piece of work of turning the meter-tap on full, the consumer should go and replace the "handle" in the economizing position. Those inspectors are an artful lot of men; and the consumer must be equally cute. The senseless thing about the whole business is that a check to the pressure and flow of gas as suggested, when there is a good number and variety of consuming points about a house—burners, cooker, fires, &c.—means loss of efficiency of the appliances, and loss of efficiency spells uneconomy and not economy. If the pressure and flow of gas are checked at the meter as suggested, they cannot be suitable for all purposes—whether one gas-jet is being used or several; the latter including perhaps the cooker and the fire. There are other ways of saving gas than as suggested by the "Evening News." We would rather have full efficiency at one burner than inefficiency at two.

## PERSONAL.

The Directors of the South Bank and Normanby Gaslight and Coke Company, Limited, have selected Mr. SAMUEL SHADBOLT, Engineer, Manager, and Secretary to the Fleetwood Gas Company, from a number of candidates, for the position of Engineer, Manager, and Secretary to their undertaking. Mr. Shadbolt has been at Fleetwood since February, 1910, following on the sudden death of his father, who had spent 32 years in the service of the Company. Previous to this, he had been for five years at Kirkby-in-Ashfield, had been in charge of the gas-works at Biggleswade for three years, and had received earlier training as Assistant first at Fleetwood and then for a short period at Grantham. During his management at Fleetwood, he has secured parliamentary powers for the Company, against strenuous attempts to force a purchase clause, and has overhauled and remodelled the works.

The Fleetwood Gas Company have appointed as Engineer, Manager, and Secretary to their works, in succession to Mr. Samuel Shadbolt, Mr. WALTER SHADBOLT, at present Manager and Engineer to the Llandudno Urban District Council Gas Department. Mr. Walter Shadbolt has been at Llandudno for over 8 years, and during this time has carried out considerable alterations and extensions on the gas-works there; while the output has risen from 70 to 115 million cubic feet. This increase is largely attributable to Mr. Shadbolt's successful development of the trade in gas for cooking and heating; the number of stoves, fires, &c., in use having been more than doubled under his management. In his early days, Mr. Walter Shadbolt was also trained by his late father on the Fleetwood works—from 1892 to 1896—following which he was Assistant to Mr. J. B. Fenwick, the Gas and Water Engineer to the East Retford Corporation. In 1899 he assumed the duties of Assistant to his elder brother, Mr. R. G. Shadbolt, of Grantham, during a time which covered extensive alterations at the Grantham works, and also a sixteen months' period of service to King and country in the Active Service Company of the old Lincolnshire Volunteers during the South African war. In 1904 he accepted the appointment of Engineer and Manager to the Horncastle Urban District Council Gas Department, where he modernized the retort-house, installed new sulphate of ammonia plant, and was highly complimented by the Local Government Board Auditor on the successful manner in which he re-organized and consolidated the financial affairs of the undertaking.

Two interesting circumstances of a personal character marked the half-yearly meeting of the Torquay Gas Company [which is referred to on another page]. The presence of Captain JOHN KITSON in the chair was a matter of gratification to the shareholders, who are naturally proud of the fact that an example in patriotism should have been set by the head of the Company, and were pleased to welcome him on a brief return from military duty. Like other companies, that at Torquay has contributed many members of the staff to the forces, with the result that those who remain to carry on the business have had exceptional calls made upon them. On the Board, the place of the Chairman is temporarily occupied by Mr. Iredale, who has long filled the position of Deputy-Chairman, and possesses an intimate knowledge of the Company's affairs. The other personal circumstances which formed a subject for congratulation at the meeting was the fact that Mr. ROBERT BEYNON (the Manager) has just completed thirty years' service with the Company, while his colleague Mr. J. DUCKWORTH (the Accountant) has twenty-one years' service to his credit. The Directors, by formal resolution, have expressed their sense of the long and faithful service of these two officers; and the shareholders heartily concurred in it.

## COKE-OVEN MANAGERS' ASSOCIATION.

### Inaugural Meeting at Sheffield.

SOME months ago it was suggested by a few coke-oven managers round about Sheffield that an Association of Coke-Oven Managers be formed in the district, and a Provisional Committee was appointed to consider suggestions, and to formulate a scheme or constitution. Notice of the meeting appeared in the Technical Press, and there was a fairly satisfactory response from coke-oven managers in the South Yorkshire district. A further meeting was held at the Grand Hotel, Sheffield, on Saturday last—Mr. G. Chrisp, of Silverwood, occupying the chair.

The object of the meeting was to consider the proposals of the Provisional Committee with regard to the constitution and formation of the Association. Unfortunately, there was not a very large attendance. A set of rules was put forward by the Committee, based on the rules of similar associations; and after some little discussion, these were adopted *en bloc*. The Association is to consist of three classes of members: (1) Full members, who must be coke-oven managers. (2) Associate members, who must be assistant managers or chemists over 21 years of age. (3) Honorary members, who must be gentlemen of distinction in connection with the industry of bye-product coking.

The annual subscription for members is one guinea; and for associate members, half-a-guinea. The Secretary is Mr. J. T. Price, of Manvers Main, near Barnsley, to whom applications for membership may be made. The Committee were empowered to draw up a syllabus of meetings, &c., for the ensuing year, and this will be published in due course.

## NORWEGIAN GAS ASSOCIATION.

WRITING from Christiania, under date Sept. 15, Mr. J. G. Tooms—late of Waterford, and who has recently taken up a position in connection with the new gas-works to be erected in the capital of Norway—gives some particulars regarding a three days' meeting (on Sept. 14, 15, and 16) of the Norwegian Gas Association, held under the presidency of Mr. O. Pihl, the Director of the Christiania Gas-Works. There was a full attendance of members.

The annual report disclosed the fact that the number of undertakings represented by the members is the same as last year—six being municipal. The consumption of gas had increased by 14·8 per cent. The consumption per head of the population, which in 1907 was only 41 cubic metres and 66·3 cubic metres last year, is now 74 cubic metres. The number of gas consumers in 1905 was 18,500; in 1914, 61,704; and at present, 68,076—showing 13 per cent. increase for the year. These figures are, Mr. Tooms writes, somewhat remarkable, in view of the cheap electricity available throughout Norway, generated by water power.

The papers read and submitted for discussion were as follows:

"The Difficulties attending the Choice of a Site for, and Description of, the Proposed New Christiania Works." By A. Ekenaes.
"Direct Recovery of Ammonia." By B. Schieldrop.
"Municipal Coal Dealing." By K. Helgeby.
"Results of Heating Sandefjord Church." By A. Hertz.

A lecture, illustrated by diagrams, entitled "Coal—its Locations, Properties, and Utilization," was delivered by Mr. Pihl, which dealt with the supply available from all parts of the world.

A report was submitted by Mr. A. Hertz, on behalf of a Committee appointed last year to consider the adoption of a standard type of consumers' apparatus. It appears that the type of cooker finding most favour is one called the "Express," manufactured in Denmark.

The Association were entertained to dinner by the Kristianie Kommune, on the last night of the meeting.

## HEAD OFFICE FOR THE GAS, WATER, AND ELECTRICITY WORKS OF BELGIUM.

A DECREE dated July 26 last, signed by Baron von Bissing, the German Governor-General in Belgium, creates a head office in Brussels for the Belgian gas, water, and electricity works. The decree is published in the "Journal für Gasbeleuchtung" of the 11th inst., with a statement that it is intended to effect closer co-operation of these works in regard to the supply of coal, the disposal of bye-products, &c. Herr Drape, formerly Manager of the Lüneburg Gas-Works, has been put in charge of the office, and also appointed Manager of the works to which coercive measures are being applied. It will be remembered that as soon as the German army had occupied a considerable portion of Belgium, Herr Drape was given general supervision over the gas, water, and electricity works in the occupied area.

The decree comprises six sections. The first states that the head office in Brussels has been created for the supervision of the gas, water, and electricity works and matters relating to them. The second that the works are required to place their products, wholly or partially as ordered, at the disposal of the head office for working-up or sale; and that the receipts will be credited to the owners. Plant which the head office deems necessary for working-up the products must be installed and operated in connection with existing plant on the works; and no claim for compensation in respect of the erection of such plant can be promulgated. The works are to follow instructions from the head office in regard to all such plant. The third section states that it is forbidden to carry out contracts relating to the products of gas, water, and electricity works which are contrary to orders issued by the head office. The fourth section enacts that no claim for damages, &c., can be promulgated in respect of breach of such contracts. The fifth section states that any member of the board, manager, or officer of an undertaking who wilfully acts in opposition to the first three sections, and more especially anyone who endeavours to deal with products otherwise than provided by the second section, will be liable to a fine not exceeding 10,000 francs (£400), to be imposed by the military, and to recovery of the proceeds or their equivalent. The sixth section states that the decree came into force at once—*i.e.*, on July 26 last.

## SIXTY YEARS AGO.

### From the "Journal" for Sept 10, 1855.

**Liverpool Gas Inquiry.**—Most of our readers will recollect that, previous to the year 1847, two gas companies in active competition occupied with their pipes almost every street in Liverpool. In that year a third company was projected to share with them the profitable trade they were carrying on; for, though competitors for custom, the price charged by both companies was uniform, and the profits were sufficiently tempting to induce the belief that there was room for a third establishment. The Town Council, however, recoiled from the responsibility of having the pavements disturbed by the introduction of a third set of gas-mains; and under their sanction a Committee of the House of Commons suggested terms upon which an amalgamation of the two existing companies should take place, and from which it was expected the public would derive all the advantages the introduction of a third company could possibly confer, without any of its disadvantages. In 1848, an Act was obtained sanctioning the suggestions of the Committee of the previous year; and since then the public have been supplied with gas extracted exclusively from Wigan cannel, at the price of 4s. 6d. per 1000 cubic feet, until Christmas last, when a reduction took place to 4s.; the Company having divided the full dividend allowed by their Act, and accumulated the authorized reserve fund. During this period, however, a party has sprung up in the Town Council, among which are some of its most active and influential members, who are desirous of seeing the gas as well as the water supply invested in the hands of the Corporation, as practised in Manchester; and the inquiry now in progress [This refers to the proceedings of a Committee appointed by the Town Council of Liverpool to inquire into the state of the gas supply.] appears to have been instituted with the view of aiding the realization of such a scheme, though, as a matter of course, when such an investigation is once begun, the door is opened to the consideration of any project for promoting private interests, under the pretext of suggesting measures having for their object the improving of the supply of gas or reducing its cost. Thus, while Mr. Robertson Gladstone and his friends are desirous of eliciting information which may tend to show the advantages of the Manchester system, Mr. Reay and his coadjutor, Mr. Flintoff, are intent on the formation of a new gas company, which will ensure to them "permanent" berths; and Mr. Taunton, availing himself of the imprudence of some of the Liverpool gas consumers in overfilling their meters with water, finds a panacea for all their wrongs in the substitution of good dry meters. . . . It is difficult to conceive how an inquiry conducted with such discordant views can produce any satisfactory results. The Gas Company have long since intimated officially their consent to the appointment by the Corporation of a public officer to test meters; and they have instructed the Borough Engineer how to determine with the greatest accuracy the illuminating power of the gas. Their officers attended the Committee, and professed their readiness to meet all the charges which could be brought against them, as soon as they were acquainted with their nature; but, when speculative opinions were sought for from those who had no practical experience upon which to base them, it became evident that the inquiry was not a *bonâ-fide* one into abuses, but an attempt to create an agitation for the furtherance of rival projects. Under these circumstances, the Gas Company had no alternative but to retire from the investigation.

### North of England Gas Managers' Association.

The half-yearly meeting of the Association will be held next Saturday at Newcastle-on-Tyne. The members will assemble at the Elswick Gas-Works for the inspection of the new plant, including an installation of vertical retorts. Subsequently, there will be a business meeting in the lecture theatre of the Institute of Mining and Mechanical Engineers, when the President (Mr. Thomas Waddom) will deliver his address, to be followed by a paper on "Some Considerations as to the Calorific Value and Calorific Standards," by Mr. J. T. Dunn, D.Sc., and a paper on "Home Sales of Sulphate of Ammonia," by Mr. A. G. Leighton, of the Sulphate of Ammonia Association.

## THE MANTLE EARTHS.*

THE lecture by Mr. Edmund White, F.I.C., on "Thorium and its Compounds," which was published at the close of 1912 as one of the series of reprints of lectures on different branches of technical chemistry issued by the Institute of Chemistry, is unsurpassed as a short monograph on the extraction of the mantle earths from monazite and other minerals, and on the analysis and assay of the commercial thorium compounds. Mr. White's exceptional knowledge of the industry of the mantle earths rendered his work unusually valuable; and so far as the analytical and technical aspects of the industry are concerned, his lecture seems likely to remain the best guide available in the English language. Perhaps sometime he may see his way to dealing more fully with the subject by preparing a concise handbook on it.

Mr. White, however, only touched lightly on possible sources of thorium other than Brazilian monazite; and a paper which Mr. Sydney J. Johnstone read last year before a meeting of the Society of Chemical Society constituted a valuable supplement in this direction to Mr. White's lecture. Mr. Johnstone gave in his paper the results of examinations of monazites from several new localities, including Travancore, which has recently come into great prominence. Mr. Johnstone has now collected this information; and with additional analyses, and a summary of the processes of mantle manufacture, has produced a very useful chapter of thirty-three pages on the "Thorium and Cerium Industry." It forms the first of the nine chapters which go to make up the manual by him and Dr. A. S. Russell on the Rare Earth Industry and the Industry of Radioactive Substances which is now before us. The ninth chapter refers to the radioactive substances, and the second to the eighth chapters inclusive treat of titanium, zirconium, tantalum and niobium, tungsten, the "incandescent electric glow lamp industry," uranium and vanadium. It is obvious, therefore, that only the first chapter deals with the mantle earths which are of direct importance to the gas industry—nearly all the remaining chapters merely interest the gas man from their bearing on the rival system of indoor lighting, which, with a tautology we do not remember to have noticed elsewhere, Mr. Johnstone calls the "*incandescent* electric *glow* lamp" [the italics are ours].

The book as a whole will probably appeal more strongly to people seeking information about the metallic filament lamp industry than to persons taking an interest in gas-mantle production. A work on either subject is, however, certain of a welcome at the present time, when home manufacture is replacing importation to a very large extent. It depends on the technical knowledge and ability of our manufacturers and their chemical and physical advisers whether this replacement endures, or whether, when international relations are restored, there is a reversion to the old condition of our dependence upon other countries for an adequate supply of mantles and glow-lamps or the essential materials for their manufacture. In so far as Mr. Johnstone's work may assist in extending the technical resources and knowledge of English mantle and electric lamp makers, we wish every success to his efforts. He has carried out his task very conscientiously and judiciously, and slips in the little volume are rare. Perhaps the worst is the statement on p. 79, that "the Hefner candle power is equal to about 1·13 British standard candles," whereas, as readers of the "JOURNAL" know well, the accepted ratio is, one Hefner is equal to 0·9 British standard candle. A minor point is that researches made by Dr. H. Lux, the well-known Editor of the "Zeitschrift für Beleuchtungswesen," are wrongly attributed to a Herr J. Lux.

* "The Rare Earth Industry, including the Manufacture of Incandescent Mantles, Pyrophoric Alloys, and Electrical Glow Lamps," by Sydney J. Johnstone, B.Sc. (London), Senior Assistant, Scientific and Technical Department, Imperial Institute, London; together with a Chapter on "The Industry of Radioactive Substances" by Alexander S. Russell, M.A., D.Sc., late Carnegie Research Fellow, and 1851 Exhibition Scholar of the University of Glasgow. London: Crosby Lockwood and Son; 1915.

**Export of Monazite Sand from India.**—A notification issued by the Indian Department of Commerce and Industry prohibits the export of monazite sand from British India to all ports in Europe and on the Mediterranean and Black Seas, other than those of the United Kingdom, France, Italy, Russia (except Baltic ports), Spain, and Portugal. The provisions of the notification are, however, not applicable to goods shipped by, or for the use of, the Crown.

**Northampton Polytechnic Institute.**—Notwithstanding the disturbance caused by the war, the equipment of the various departments at the Institute was in several directions extended during last session; and the programme of work for the new session indicates generally that it has been decided to continue the different regular classes which have hitherto been a feature of the work done. There are day and evening engineering courses—the civil, mechanical, and electrical branches being included—and technical chemistry is another subject dealt with. In connection with the evening classes in engineering, however, the Principal (Dr. R. Mullineux Walmsley) states that it has been found impossible to arrange for special series of advanced lectures, as the possible lecturers who have been approached are engaged in work directly or indirectly concerned with the war.

## ELECTRICITY SUPPLY MEMORANDA.

THE electricity industry is not in very happy mood. The expenditure of money on new electricity schemes and generating plant extensions, in consonance with the general policy, is being discouraged by the Treasury and the Local Government Board, unless the outlay is absolutely necessary for the provision of electrical energy for establishments engaged on Government work; but the plea that this is the specific purpose for which money is required will not much longer hold good, seeing that factories engaged on the production of munitions are now working "full bore," and so are supplied with all the electrical energy needed. It is only the new enlistments of factories that will probably seek assistance. On top of this, the Local Government Board have notified municipal concerns that no money must be spent on extensions of mains or new services other than for firms employed on war work. Consequently, electrical contractors do not like the appearance of things. They are paying higher wages; taxes on profits are greater; and the scope for business is very limited. Even the present electricity consumers will not contemplate the spending of money on new electrical goods, which are at ordinary times expensive in contrast with gas appliances, and are much more so now. Shopkeepers and householders smile quite good naturedly at the essays to tempt them; but they give a decidedly negative shake of the head. The expenses of electricity concerns, like those of gas undertakings, have advanced all round—not only for coal, but in other ways; and business has diminished considerably through reduced shop lighting, street lighting, and the economies of householders. The advantage possessed by the switch is not a neglected one to-day. In the circumstances, most concerns have raised the price of current. They could no more help doing this than gas undertakings their commodity. Coal has gone up considerably in price, compared with a few years ago. The standard increase of 4s. is only part of the higher figure paid in contrast with days when pre-war tariffs for electricity were fixed. For example, one chairman of a municipal electricity undertaking states that 21s. 4½d. is now being paid by the department for fuel similar to, and no better than, what was being purchased for 8s. 7d. only eight years ago. On top of this, the concerns have to carry larger stocks, and these of the more expensive coals, which also means increased outlay. The Board of Trade have very properly circularized the undertakings urging them to put greater quantities of coal into store, owing to anticipated difficulties during the next winter. The higher expenses for fuel only constitute one of several enhanced charges. Materials and labour all cost more. Charges for electricity have generally gone up by so much per unit, or, what is a popular method, by adding 10 per cent. to the accounts of consumers. In the case of some undertakings, 20 per cent. has been added to the charges for power, cooking, and heating. If the tariffs for these three purposes were fair before the war, then why is not 10 per cent. an adequate addition as in the case of lighting? It is not necessary to search about for an answer.

**Economy Everywhere.**

**Extra Street Lighting Reductions.**

After the war, will a new policy obtain in regard to street lighting? Will our local authorities, through their experiences now, decide to put the brake on the progress in prodigality that some of them prior to the war were making in installing electric lighting for street illumination? We cannot say; but it would not be astonishing to find it so. Far from the scenes of raids by enemy aircraft, the wrecking of the homes of civilians, and the blowing from life into eternity of men, women, and children, local authorities have lessened street illumination, for the sole purpose of economizing. It is, of course, a right thing for them to do to reduce as much as possible the claims of local government on the pockets of the ratepayers, when these pockets are acutely feeling the strain of providing money for the war, and meeting the increased cost of necessaries. Example by our rulers—even though the rulers be only local ones—is proper. In other cases in the danger zone, the reduction of lighting that was at first thought sufficient to hide the identity of towns, streets, and property, has either been deemed insufficient, or the local authorities have found that public lighting is a convenient means for producing much-needed current economy. The lessons of the present will not be lost upon them, though we are among those who would be sorry to see a continuation of the depressing after-dusk conditions of our streets any longer than Germany thinks that by raids, murder, and destruction of private property, military ends are served, honour is gained, and their attempts at justification will find acceptance at the Judgment Seat. The further lessening of public lighting decided on in many places is to a substantial extent, as measured by money. Example will suffice. Brighton has resolved to lower the expenditure for street lighting by a further £5000 a year. This, added to the former reduction, represents a loss to the Electricity Department of £9000 per annum. Last half year the Gas Company sold to the Corporation 14 million cubic feet of gas less for public lighting. Running over to the west, the Cardiff Corporation have determined to bring down the estimate of £9850 for the street electric lighting to £7586—a reduction of £2264. Lamps that have hitherto been extinguished at midnight are now to be extinguished altogether. The Gas Company have had notice from the Corpor-

ation to "close down" about half the lamps supplied by them. This will result in an estimated saving in cost of £3826. In Aberdeen, reduced street lighting has resulted in a saving of £5352. These are only instances of what is going on all over the country.

**When Peace is Declared.**

Months ago "Installation Topics" in "Electrical Times" was urging manufacturers to begin to make preparations for illumination work on the Declaration of Peace. "D" and "P" capitals please, as the words want a lot of enforcing to enable one, while things are as they are, to fully appreciate their meaning. Declaration of Peace seems to be something that is so far ahead that we hardly dare to think much about it, though confident that, when it comes, it will be so completely in favour of the Allies that we shall not think it very much amiss if a bit of extravagance is indulged in in celebrating the event by great rejoicing. There will certainly not be in our times another occasion for a display in connection with the end of such a mighty and tragic war; and no one would desire it. However, though the end of the terrible conflict is hidden somewhere, as appearances are, in the distant future, the writer of "Installation Topics" is again urging preparation by manufacturers, and the placing of orders by electricity undertakings, so that there shall not be disappointment when the rush comes. We have not so far seen any sign of preparation for rejoicing; for the time being, money, energy, and machinery are needed for prosecuting, and must be concentrated upon, the work that is necessary for victory. What money, energy, and machinery there are to spare from munitions work are all required for greater necessaries than illumination strip, electric carbon lamps, and illumination devices. The preparations for rejoicing can well be put off until the end is a good bit nearer than it is to-day, when we can begin to breathe more freely again, and seek some rest from the present continuous strain. It is rather imagined, too, that electrical manufacturers cannot, any more than other people, afford to let dear money lie idle in stock, for perhaps many long and dreary months, in anticipation of an event which will come—but, when? This money may be badly wanted ere the days of rejoicing and of public illuminations arrive. In the lugubrious streets of London on these nights, our imagination will not run to picturing them yet awhile flooded with lights from myriads of electric lamps, scintillating gas jets, and monstrous flares.

**Automatic Cooking.**

The Westinghouse Company of America are attempting to dispense largely with the human factor in cooking (which factor is liable to err) by applying automatic control of time and temperatures to electric-ovens. But as different cooking operations—different meats, different foods, and different weights—require different times and temperatures, we are afraid that the human factor will be needed as much as ever for giving attention if there is not to be a good deal of failure, spoiling of food, and disappointment. Automatic control, too, has a nasty knack of breaking-down. However, a description of the American Westinghouse innovation will be of interest to readers of the "Memoranda;" and for these particulars we are indebted to the "Electrical Times." The ovens are arranged for automatic temperature and time control, thermometers in the oven doors being set for the desired temperature and a clock adjusted for the time at which it is desired cooking should commence. When the hour arrives, the circuit is closed automatically and the ovens begin to heat-up. As the ovens reach the desired temperature, they are switched off automatically by the thermostat, but cooking continues for some time with the residual heat stored-up in the ovens. The complete range comprises a couple of ovens, one above the other, and three boiling discs. The larger oven is rated at 1·5 KW. and the smaller at 850 watts, one 10-inch boiling disc taking 1·5 KW. at full heat and two 8-inch discs 1000 watts each. Three-heat control for the discs, which have readily replaceable elements of the radiant type, is arranged for by rotary switches mounted on the front. A smaller range is supplied, this having only one oven. The elements employed in the cooker are spiral wires laid in deep grooves in a moulded porcelain compound that does not chip or crack under extreme heat, and is impervious to water, acids, and alkalies. "With a range of this kind," it is said, "it is a simple matter to prepare meals, for the food is placed in the ovens and the thermostat and clock set to suit the class of cooking being done and the time when the meal is required. No attention, meanwhile, is required; the housewife may go out or attend to other duties in the certainty that, when meal time arrives, the food will be ready cooked, with a minimum power consumption." We are not sure about the "certainty."

**Belated.**

Our friends of the "Electrician" have been dozing. It has just come to their knowledge that, some time or other, an appeal was heard at the Limerick Quarter Sessions against the rates being utilized for the purpose of meeting the deficit on the working of the electric lighting concern. The grounds of the appeal were that, under their Provisional Order, the Corporation had power to charge up to 8d. per unit for current, and, until this figure was reached, the Order did not contemplate that any charge should be made on the rates. Mr. O'Brien, the appellant, won the action. There is a little resentment in the country that certain important items of news regarding the war are kept too long from the nation by the controlling forces at Westminster; but the offence on their part so far as delay is concerned is of an infinitesimal order compared with that of the "Electrician" on this occasion. The case at the Limerick Quarter Sessions was reported in the "JOURNAL" for June 10, 1913 (p. 753); the "Electrician" reports it on Sept. 17, 1915—only two years and three months after the case was argued, and the Court held that the Corporation had overstepped the limits of the statute when, with something in hand in regard to price authorization, they placed an extra rate of 5d. on the ratepayers to make good the deficit on the working of the electric-light department!

**"Half Watts" in Street Lighting.**

The "Electrician" recently gave data as to the electric street lighting in Chicago, together with the subjoined comparative figures of costs. The Chicago system of electric street lighting is stated to be the largest in the world. At the present time, there are in use 7200 100-candle power series tungsten lamps, 10,000 series flame arcs of the latest type, 8000 600-candle power type "C" tungsten lamps, and 3000 7-ampere enclosed arcs. The latter lamps are being rapidly displaced by the 600-candle power type "C" units; and it is estimated that, by the end of 1915, a total of 15,000 of these units will be installed. The comparison of operating costs was given recently by Mr. R. Palmer, of the Chicago Municipal Department of Gas and Electricity.

*Comparative Operating Costs under Chicago Conditions.*

| Items of Cost. | 465 Watt Flame Arc. | 325 Watt Nitrogen Tungsten. |
|---|---|---|
| Power (at $15 per H.P. per year) | $10·25 | $7·16 |
| Sub-station operation | 1·00 | 0·70 |
| Carbons or renewals | 4·90 | 8·00 |
| Repairs to lamps and fixtures | 1·75 | 0·50 |
| Globes | 0·70 | 0·40 |
| Trimming | 3·89 | — |
| Patrolling | 2·70 | 1·99 |
| Cleaning globes | (inc. in trimming) | 1·73 |
| Repairs to circuits and posts | 5·40 | 5·20 |
| Miscellaneous expense | 0·23 | 0·23 |
| Office expense and superintendence | 0·30 | 0·45 |
| | $31·12 | $26·36 |
| Fixed charges on aerial construction | 19·19 | 14·30 |
| Total annual cost per lamp | $50·31 (£10·1) | $40·66 (£8·1) |

It is mentioned that the fixed charges include interest at 4 per cent., taxes at 1·5 per cent., and depreciation at an average rate of 5·5 per cent. upon lamps, posts, line construction, sub-station buildings and equipment, transmission lines, &c.

## WATER LEGISLATION FOR 1915.

[SECOND ARTICLE.]

IN the preceding issue of the "JOURNAL" [p. 634], the provisions of the Water Companies' Acts of the present session were noticed. We now indicate the powers in regard to the supply of water which have been granted to local authorities:

The Ammanford Urban District Council have, in a General Purposes Act, obtained authority to lay pipes in private streets, repair communication-pipes, maintain pipes used for the supply of water to several houses, or parts thereof, in the occupation of different persons, and fix and maintain appliances for the prevention and detection of waste. Where water is used in stables by means of a hose-pipe, the Council are authorized to charge not exceeding 20s. additional per annum for it. [*Parliamentary Agents: Messrs. Bircham and Co.*]

Additional powers in regard to their water undertaking have been obtained by the Ashington Urban District Council. They are authorized to construct a service reservoir in the parish of Cockle Park, four aqueducts in the parish of Newtown, and two others in the parish of Tosson, all in the county of Northumberland; and they are granted seven years within which to complete them. The Council may borrow £73,000 for the purchase of lands and easements for, and the construction of, the above-named works, and £8000 for new mains, service-pipes, &c.; the former amount to be repaid within sixty, and the latter within thirty, years from the date of borrowing. The Act contains a number of protective provisions, and confers on the Council power to supply water in bulk to the Morpeth Rural District Council. [*Parliamentary Agents: Messrs. Lees and Co.*]

The Barnoldswick Urban District Council are authorized to construct new works, comprising an impounding reservoir in the parish of Elslack, a service reservoir, two aqueducts or pipe-lines, a catch-water conduit, and a road diversion, all in the West Riding of the county of York; and ten years are allowed for their completion. Until the impounding reservoir is finished, or the expiration of a period of ten years from the passing of the Act, whichever date is the earlier, the Council are to take water from the Elslack Beck; but afterwards they may discharge during each working day of 24 hours not less than 172,000 gallons of water into the beck, and not less than 10,000 gallons into the Acre Gill Beck, in a continuous flow. Provision is made for treating the water for the prevention of plumbism, and for affording a supply

in bulk to the Earby Urban District Council. Borrowing powers are conferred to the amount of £99,155 for the purchase of lands and the construction of works, and £3000 for new mains, service-pipes, &c.; the former sum to be repaid within sixty, and the latter within thirty, years from the date of borrowing. [*Parliamentary Agents: Messrs. Lees and Co.*]

A short Act has been obtained by the Bury and District Joint Water Board extending the time for the completion of works authorized by their Act of 1903. By section 19 of that Act a certain period was specified for carrying out the New Hall and the Scout Moor reservoirs. This, however, was extended by the Board's Act of 1908; and a further extension is now granted to ten years from Aug. 14, 1920. By section 3 of the Act of 1908 the time specified in section 22 of the earlier Act for the compulsory purchase of lands was extended; and by the Act now under notice the Board obtain a further extension to seven years from Aug. 14 last. [*Parliamentary Agents: Messrs. Lewin, Gregory, and Anderson.*]

The Doncaster Corporation have obtained a General Purposes Act which contains provisions in regard to their gas and water undertakings. Those relating to gas supply were noticed in the "JOURNAL" for the 7th inst. (p. 496); and we now indicate the nature of the others. The Corporation are authorized to construct a service reservoir in the parish of Warmsworth, in the rural district of Doncaster; and they are granted seven years for its completion. Miscellaneous provisions relate to the supply of water for motors and in bulk outside the limits, the detection of waste, &c. Authority is given to borrow £16,000 for the construction of the reservoir; and fifty years from the date of borrowing are allowed within which to repay it. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

Two sections of the Lincoln Corporation Act (the gas portion of which has already been noticed) relate to the supply of water. By one it is provided that, notwithstanding the provisions of section 30 of their Act of 1908, relating to the price of water sold by measure, the Corporation may require that the charge to be paid for water so supplied for domestic purposes to any building shall not be less than the sum which would be chargeable for a supply given to the occupier of such building otherwise than by meter. The other section enables the Branston and Welton Rural District Councils to afford a supply of water to certain places specified, and the obligation of the Corporation in this respect ceases. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Lurgan Urban District Council, as notified in the "JOURNAL" early in the year, promoted a Bill to obtain authority for the transfer to them of the undertaking of the Lurgan Gas Light and Chemical Company, Limited. They obtained the necessary Act, and the gas portion of it has been duly dealt with [*ante*, p. 496]. It also contains several provisions relating to the supply of water which call for brief notice here. If water for domestic purposes is used for stables, washing motors, &c., by means of a hose-pipe, an additional sum not exceeding 20s. per annum may be charged; and authority is given to the Council to make bye-laws for the prevention and detection of waste, to supply meters and fittings, repair communication pipes, &c. [*Parliamentary Agents: Messrs. Lees and Co.*]

Important extensions of works are authorized by the Act obtained by the Metropolitan Water Board. A reservoir is to be constructed at Southgate, another at Eltham, two at Bromley, and two others at Farnborough and Shoreham respectively. In connection with these works eight aqueducts or pipe-lines are to be made; and there will be a well and pumping-station at Eynsford and a subway or tunnel in Camberwell. If the last-named work is not completed within five years from the passing of the Act, the power to make it is to cease, except as to the portion that may be finished. Fifteen years are granted for the carrying-out of the other works. Full provision is made for the protection of gas, water, and electricity mains and sewers. In the portion of the Act dealing with finance, it is provided that, as from the date of the Act, subsection 12 of section 22 of the Metropolitan Water Board Act, 1906, is to be read and have effect as if the sum of £2,000,000 had been referred to instead of £1,000,000; and the other provisions of the section are to be read and have effect accordingly. The Board have obtained power to borrow the following amounts: For the purchase of lands and the construction of reservoirs, &c., £285,150; for the aqueducts or pipe-lines, &c., £365,350; for the provision of machinery in connection with the authorized works, £32,000; and, with the sanction of the Local Government Board, such further amount as may be required for the purposes of the Act. For the repayment of the first-named amount the Board are granted sixty years; for the second, fifty years; for the third, twenty years. For the moneys borrowed with the sanction of the Local Government Board, the period for repayment will be such as they may prescribe. Provision was made in the Bill for the purchase by the Board, by agreement with the Corporation of Hertford, of the rights and interests (if any) in the Manifold Ditch, the Black Ditch, and several other ditches or watercourses specified; but this does not appear in the Act. When the Bill was in Committee a clause was inserted giving all the local authorities concerned the right to reinstate the surface of roads after the filling-in had been done by the Board. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Plymouth Corporation have obtained power to consolidate, with amendments, certain of the Local Acts in force in the borough, and make further provision in regard to its health, local government, and improvement. The Act is one of the bulkiest of the session, containing 264 sections and eleven schedules, which occupy 250 foolscap pages. Part III., relating to the supply of gas, has already been noticed [*ante*, p. 496]. Part II. is devoted to water. It is provided that the water undertaking as it exists at the time of the passing of the Act is to continue vested in the Corporation and held, used, and enjoyed by them. Power is given to provide and maintain water-works, lay down mains, hold lands and exercise powers for the protection of waters, and make bye-laws for the prevention of waste. The limits of supply are the borough and neighbouring parishes; and the charges for water for domestic purposes vary with the annual value of the premises supplied—ranging from 4s. where this does not exceed £5, up to 2 per cent. when it is above £100, and £6 where it exceeds £300, together with a sum equal to £1 10s. per cent. of the amount of such yearly value in excess of £300. The Corporation may supply water by meter for domestic, shipping, or other purposes; but the ordinary supply for shipping is to be at the rate of 1s. 6d. per ton, and 1s. for any fractional part of a ton. The Act contains the usual clause as to water used for stables, motors, &c., by means of a hose. The Corporation are authorized to borrow £60,000 for the construction of a conduit and water-mains; sixty years being granted for its repayment. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

An Act obtained by the Rhondda Urban District Council confers upon them (*inter alia*) further powers with respect to their gas and water undertakings. The sections bearing upon the supply of water authorize the Council to repair and maintain communication pipes, and to charge an additional sum not exceeding 20s. per annum for water used for stables, washing motors, &c., by hose-pipe. [*Parliamentary Agents: Messrs. Torr, Durnford, and Co.*]

The Corporation of Sunderland have obtained an Act authorizing them to reconstruct Wearmouth Bridge, and in so doing to interfere with the gas and water mains and pipes. It contains ample provisions for the protection of the Sunderland Gas Company and the Sunderland and South Shields Water Company, as noticed in the "JOURNAL" for the 7th inst., p. 496. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Wolverhampton Corporation have secured power to construct additional water-works, extend their limits of supply, and make further provision in regard to their water undertaking. The new works comprise a pumping-station in the parish of Lapley and Wheaton Aston, in the rural district of Cannock, a service reservoir in the parish of Brewood, and two aqueducts or pipe-lines. Seven years are granted within which to complete them. The wells are to be lined with steel or iron tubes for a depth of 300 feet below the surface of the ground, or to the bottom of the Keuper sandstone, whichever shall be the lower. No adit or other similar work is to be driven or constructed above the level of the bottom of the lining. If, after the pumping-station has been finished, a diminution or cesser is caused in the supply of water from any well or spring within a radius of two miles which is used as a source of water supply, the Corporation are to make good the diminution. The limits of supply are extended so as to include several parishes or parts thereof in the rural district of Cannock in the county of Stafford. Section 142 of the Corporation's Act of 1869 is amended in regard to the maximum water-rate, by the substitution of 8s. 8d. for 10s., and by the repeal of the portion limiting to £10 the amount received for a supply. This section will come into operation on Sept. 30, 1916. The Corporation are authorized to place meters in the streets for the purpose of detecting waste or measuring water, and to enter into contracts for the sale of water in bulk. Permission is given to borrow £80,000 for the purchase of lands and the construction of works, and £40,000 for the extension of mains, to be repaid in fifty and forty-five years respectively. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

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**Gas Production in Germany.**—The statistics collected by the Central Gas Publicity Bureau of Berlin show that the production of gas by 862 German gas-works in the month of June last was 2·8 per cent. more than by the same works in June of last year. This is the first month since the war started in which the production of gas in Germany has been higher than in the corresponding month of the previous year. Statistics for the month of May were given in the "JOURNAL," Vol. CXXXI., p. 337, where reference will also be found to earlier reports.

**Importation of Tar and Pitch into Russia.**—The "Chemical Trades Journal" reports that No. 80 of the Russian Customs Tariff provides for the levy of Customs duty at the rate of 9·9 copecks per pound (gross) on "tar and pitch of all kinds, not specially mentioned" imported into Russia; and No. 83 provides for an import duty of 33 copecks per pound on "coal-tar pitch, bituminous mastic, and all kinds of fusible asphalts." H.M. Commercial Attaché at Petrograd reports that, according to an explanation which has been furnished by the Director of the Russian Customs Department, only the entire liquid product derived from the dry distillation of coal, not subjected to any further process whatsoever, and therefore containing in its composition ammoniacal liquor and benzol, is assessed for duty as coal pitch or coal tar under No. 80 of the tariff. The product differing from coal tar by the absence of this ammoniacal liquor and benzol is regarded for tariff purposes as coal-tar pitch, and is subject to the higher duty prescribed by Tariff No. 83, unless it is imported for the manufacture of briquettes, in which case it is admitted free of Customs duty, in virtue of a special law.

# THE PRODUCTION AND RECOVERY OF TOLUENE FROM ILLUMINATING GAS.

In last week's "Journal," p. 635, an article on this matter—contributed by a well-known gas engineer—referred to a process patented by Mr. A. Rollason, of Long Eaton, which also formed the subject of an application for Letters Patent, the specification of which was abstracted on p. 652, of the same issue. The question is dealt with in two pamphlets issued by the Synthetic Gas Processes Company, Limited, of Nottingham. The first of these, issued last month, is entitled

## NOTES ON THE CARBONIZATION OF COAL.

By A. Rollason.

The patentee has been specially engaged during the last five years in experimenting on the carbonization of coals, with the object of increasing the amount of gas and oils previously obtained.

Some hundreds of samples of coal from different seams in the British coal areas have been examined and tested in the laboratory and in full-sized retorts. As the result of this research work, patents Nos. 18,744 of 1911, 21,374 of 1911, 19,697 of 1913, and 18,490 of 1914 have been taken out and are in practical use.

It is well known that the ultimate toluol content in coal tar can be increased by washing the gases, after cooling, by the tar made during carbonization—as in the "C" process of the High-Explosives Committee.

The writer's experiments have proved that the results to be so obtained depend upon many considerations, viz.:—

1. The class of coal used, its age, percentage of oxygen, and possible yield of hydrocarbons.
2. The temperature at which the coal is carbonized.
3. The permissible practical margin above the calorific value of the gas necessary for the particular district.

As to 1.—With the high-class gas coals (such as Durham, Lancashire, or West Yorkshire), which are low in oxygen, the results may well be expected to be quite good, inasmuch as the quality of the coal lends itself to the production of large quantities of gas of high quality, and thus the toluol content should he high. It must be conceded, however, that, since the general reduction in the illuminating power standard, many gas undertakings have used a much cheaper coal.

The author's patent process should particularly appeal to the latter undertakings, as practical tests have proved that (without tar washing and the consequent loss in calorific value, *plus* the naphthalene trouble, a difficulty to be reasonably expected) a greatly increased toluol content can be obtained at trifling cost; and the Government may be sensibly helped in the present crisis of the country.

As to 2.—By the "Synthetic Process" the temperature of the retort may be considerably reduced, and an increased quantity of gas obtained, besides an increase in the quality of the gas.

As to 3.—It must be remembered that many gas-works, with modern high temperatures, and consequent high yields, strip their coals and partially decompose the hydrocarbons in the gas, and that therefore, unless the temperature is reduced, there is no margin of hydrocarbons in the gas for tar washing.

## INCREASED YIELD OF HYDROCARBONS IN GAS AND TAR.

The later pamphlet, now ready to be put into circulation, gives further particulars of Rollason's "Synthetic Process for Increasing the Yield of Hydrocarbons in Gas and Tar."

It is pointed out that the reduction in the illuminating power standard has enabled gas engineers to utilize, for the production of gas, the second-grade coking and semi-coking coals, of which large supplies are available in most of the coal areas in this country. The principal drawback to their use is their high oxygen and sulphur content. When high temperatures are used for their carbonization, the coke and tar are of inferior quality.

Several proposals, based upon the addition of from 4 to 5 per cent. of lime to coking coals before carbonization, have been made to improve the quality of the coke and to reduce the sulphur in the gas. None of these have, however, had any general practical result.

During a series of experiments carried out by the Syndicate with a view to the use of second-grade coking and semi-coking coals for the production of gas, it has been found that many of these coals which contained a high percentage of hydrocarbons gave off their volatile contents so rapidly, at the commencement of carbonization, that when high temperatures were employed the hydrocarbons in the gas split-up into methane and hydrogen—leaving the carbon in the amorphous form, with the result that the coke was soft and friable and the tar poor in quality.

The numerous trials carried out showed that lime did not always improve the quality of the coke, but frequently had the opposite effect. Further experiments, however, finally showed us that we could attain our object—namely: To improve the quality and increase the quantity of the gas, increase the quantity of ammonia, reduce the sulphur content of the gas, and considerably improve the coke and tar, by adding lime in the form of limestone in certain proportions to these coals before carbonizing at a temperature above 850° C.

Our experiments showed that the most suitable proportion of lime to be added to the coal should be sufficient to transform the silicates contained in the ash of the particular coal used into a neutral silicate of approximately the type $SiO_2CaO$.

The only point of similarity between the former liming proposals and the present process consists in the broad fact that coal and lime are used to obtain the desired result. Beyond this, our proposals are quite distinctive in the principles which form the basis of our invention [see "Journal," April 16, 1912].

It is an easy matter by a simple calculation, based on the analysis of the coal and the composition of the ash contained therein, to arrive at the correct quantity of limestone required.

The action of limestone is entirely different from that of lime. Limestone, when intimately mixed with coal rich in hydrocarbons and with a high oxygen content, commences to decompose at a lower temperature than that of the resinous and other matters contained in the coal.

In order to determine the action of limestone, we have made numerous trials on second-grade coking and semi-coking coals, at high and low temperatures of carbonization, in charges varying from 2 cwt. to 9 tons, to which limestone in different percentages had been added. Under the conditions existing in retorts and coke-ovens, the limestone, when intimately mixed with these coals, commenced to decompose at approximately 130° C. Apparently the actions which take place during carbonization are: The calcium oxide when freed from its neutralizing agent, carbon dioxide, is in a nascent condition, possessing active chemical and catalytic properties, which assist in the decomposition of the volatile matters and organic bases contained in the coal, and facilitate the combination of oxygen and hydrogen so as to form water, and carbon and hydrogen to form hydrocarbons, thereby largely increasing the volume of hydrocarbons in the gas and tar.

The reduction of the excess of oxygen by the formation of water taking place at an early stage of carbonization and before the iron sulphide decomposed, limits the formation of oxygenated hydrocarbons and sulphur compounds.

The possibilities of considerably increasing the production of gas and ammonia from second-grade coking and semi-coking coal has encouraged us to continue our experiments during the last four years, in the face of numerous difficulties; and we have now achieved results which, at the present time, should be of great value to gas engineers.

The following comparative results were obtained at a modern carbonizing works, on coal an analysis of which showed that it contained in a dried sample (per cent.):

Ash 3·82, C. 76·78, H. 5·75, O. 10·62, S. 1·62, N. 1·41.
Coal broken to 2½ inches downwards.
Temperature of carbonization inside retorts: 1180° to 1210° C. (machine-stoked horizontals).

| | Per Ton of Coal. | |
|---|---|---|
| | Coal. | Coal and Limestone. |
| Gas washed with anthracene oils, distillate 0° to 220° C. | 4·28 gallons | 6·55 gallons |
| Toluene in distillate | 2·96 lbs. | 3·8 lbs. |
| Toluene recovered from tar | 0·14 lbs. | 0·41 lbs. |
| Gas washed by the "C" process: | | |
| Calorific value of gas after washing, B.Th.U. per cubic foot shown on continuous recording calorimeter | 537 | 555 |
| Cubic feet of gas after washing, registered on station meter | 11,510 | 11,928 |
| Toluene recovered from washing tar | 0·27 lb. | 1·01 lbs. |

The coke was greatly improved, and a larger percentage of saleable coke was produced. The sulphur in the gas was sensibly decreased. The yield of ammonium sulphate was increased. The tar was of an improved quality. The results obtained at a lower temperature of carbonization were:

| | Per Ton of Coal Carbonized. | |
|---|---|---|
| | Coal only 2 in. to 1 in. | Coal and Limestone, Coal below ¾ in. |
| Temperature inside retort, 900° C. | | |
| Cubic feet of gas per ton of coal carbonized | 8560 | 9600 |
| Gases washed with anthracene oils, toluene recovered from distillate | 1·82 lbs. | 4·87 lbs. |
| Toluene recovered from tar | 0·147 ,, | 1·91 ,, |

It is therefore possible with this process, by crushing the coal sufficiently fine for the purpose of increasing the surface-contact of the limestone with the coal, to increase the normal yield of gas, which, upon washing by the "C" process, will give a large quantity of toluol in the tar and leave a gas containing sufficient light hydrocarbons to prevent the deposition of naphthalene.

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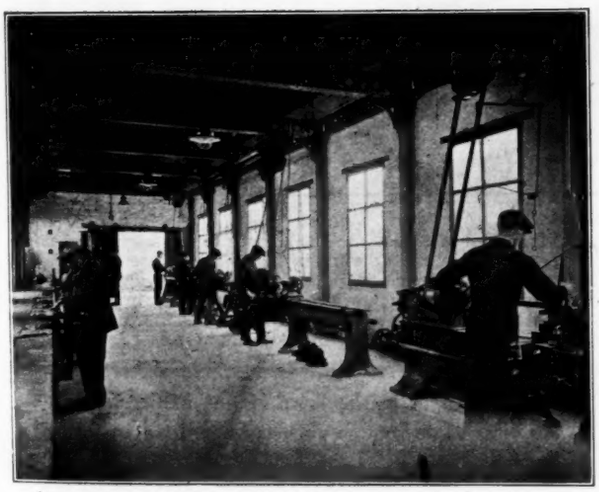
According to the "Manchester Guardian," the Association of German Silk Dyers have issued a circular stating that dye prices are to be again advanced on Oct. 1—those for fancy shades being increased 20 per cent. and for blacks 30 per cent.—making the increases since the outbreak of the war 40 and 50 per cent. respectively. The explanation, no doubt, is that most of the coal-tar products in Germany are required in the manufacture of high explosives, and that in any case the demand for dyes would be very small in the present depressed conditions of the textile industries of the country.

## CARDIFF MUNITIONS SCHOOL.

THE premises which have, as already recorded in the "JOURNAL," been specially erected by the Cardiff Gas Company on a portion of their land at Grangetown, for the purpose of holding classes for munition workers, under the Technical Schools Committee, were formally opened last Wednesday by the Lord Mayor (Alderman J. T. Richards). The building, in the provision of which acknowledgment is made of the kind offices of Mr. George Clarry (the Secretary and General Manager of the Company) is admirably suited to the work; and, as will be seen by the photographs, it contains an excellent assortment of lathes and other necessary tools—which have been furnished by the Gas Company and by other of the local employers. In this way, an excellent munitions school has been completed within six weeks; and at the time of opening some 270 persons had registered for entry to the classes, which will be worked on the shift system. No fees will be charged for tuition; but grants will be obtainable from the Board of Education.



The opening ceremony was presided over by Mr. J. Stanfield (the Chairman of the Technical Education Committee of the Corporation), who remarked that the action of the Gas Company showed great patriotism. In addition to the building and plant, they had provided cooking facilities. The Committee were very grateful to them, and to the other employers who had kindly lent lathes. The Lord Mayor, in declaring the building open, also voiced the gratitude of the city to the Company and to those firms who had done so much to start the classes.

In response to a vote of thanks, Mr. C. E. Dovey (the Chairman of the Company) said that when the proposal to provide premises was put before the Board, it was agreed to with alacrity. The knowledge that students could come there and learn to manufacture munitions was a sufficient reward at this time for what the Company had done. Mr. Clarry remarked that the scheme was launched with the idea of forming a link between the schools and the factories.

## CARBONIZATION OF LIGNITE TAR.

REFERENCE was made in descriptions of the plant at the new Obuda Gas-Works at Budapest [*ante*, p. 24] to the producer plant used for the consumption of brown coal or lignite. In a recent number of the "Journal für Gasbeleuchtung," Herr Viktor Schön the Deputy-Manager of the works, gave a description of the tar obtained from this producer plant and the method in which it is disposed of on the works.

He points out that where it is necessary to remove all the tar from lignite producer gas, the tar is an unwelcome bye-product. Generally, it contains a high proportion of water—up to 40 per cent.—which renders its working-up a difficult matter. By prolonged settling and heating, the water can be reduced to from 10 to 12 per cent.; but even so the lignite tar fetches only one-quarter to one-third the price obtainable for coal tar. In view of these facts, Herr Schön tried disposing of the lignite tar by introducing it into the large carbonizing ovens in use at the Budapest Gas-Works. The results showed that the whole of the lignite tar produced could thus be gasified without difficulty, and that the water in the tar was really a matter of no importance as it was only evaporated and again condensed with the liquor and coal tar. A portion of the vapours from the lignite tar remained as heavy hydrocarbons in the gas, and appreciably increased its calorific power; while another portion of the tar was converted to coke. The rest of the lignite tar mixed with the coal tar and had no injurious effect on the quality of the latter.

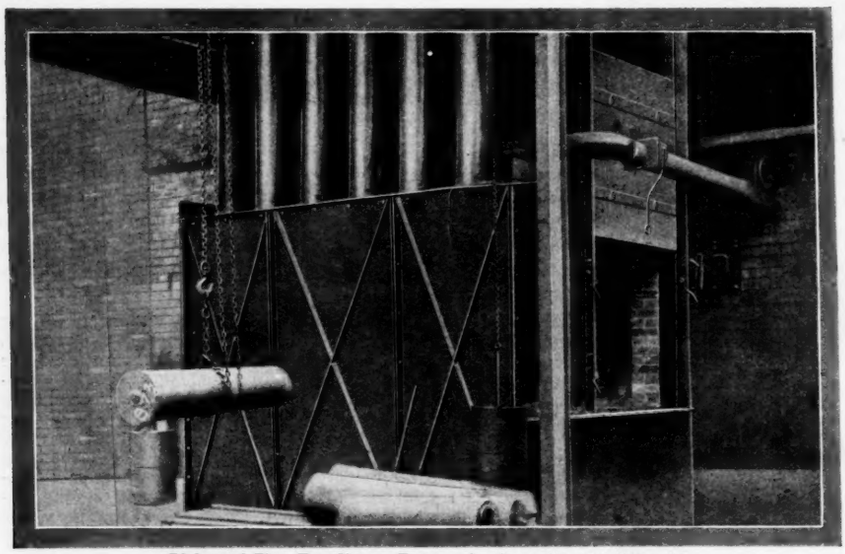
In a trial which was made of the method, the lignite tar was run into one of the carbonizing chambers from the twentieth to the twenty-third hour of the twenty-four hours' period allowed for working-off the charge. In the trial, the gas produced in this chamber was kept apart from the rest of the works' production; being led into the apparatus of the experimental plant of the works. The quantity of tar introduced into the chamber was 220½ lbs., representing approximately the lignite tar obtained in the production of the quantity of producer gas required for heating one carbonizing chamber. The lignite tar flowed, at a temperature of about 95° Fahr., through a swan-neck pipe into the chamber. The tar, as used in this test, contained 8 per cent. of water, 4·6 per cent. of oils distilling below 200° C., 33·8 per cent. distilling between 200° and 300° C., 32·8 per cent. distilling between 300° and 360° C., and 20·3 per cent. of pitch. The average calorific value of the coal gas before the introduction of the tar was 375 B.Th.U. per cubic foot; during the addition of the tar, 414 B.Th.U.; and when the introduction of the tar was stopped; 358 B.Th.U. The difference in the quantity of gas produced during the three hours the lignite tar was being introduced is not so readily ascertained; but, assuming that the lignite tar would produce a gas of 838 B.Th.U. per cubic foot, Herr Schön calculates that, of the 11,089 cubic feet of gas produced in the three hours, 1014 cubic feet were obtained from the lignite tar. The aggregate calorific value of the gas produced from the tar would therefore be 850,000 B.Th.U., which is equivalent to about 1570 cubic feet of coal gas of 540 B.Th.U. Comparisons of carbonization with and without the addition of tar have shown, on the average, a difference in the make of gas per chamber of 1342 cubic feet. Analyses of the gas made at this stage of the carbonization showed that the proportion of heavy hydrocarbons was 1·1 per cent. when the lignite tar was being carbonized, as compared with 0·7 per cent. before the introduction of the tar. Trials have further shown that from 100 lbs. of the lignite tar, having a calorific value of 1,170,000 B.Th.U., 374,400 B.Th.U. go into the gas, 57,600 B.Th.U. remain in the coke, and 738,000 B.Th.U. are transferred to the coal tar. The effect on the character and composition of the coal tar is practically negligible. The products resulting from the lignite tar utilized in this way give it a value about 60 per cent. of that of coal tar.

## GAS FOR WAR WORK.

In a wrapper designed and executed by artists, the Richmond Gas Stove and Meter Company, Limited, have produced a booklet of considerable interest, illustrating and briefly describing, as it does, some of their furnaces engaged on war service. The advantages of gas for manifold operations carried on in connection with the preparation of material for both attack and defence has been recognized in all quarters; and the measure of the popularity enjoyed by Richmond gas-furnaces is indicated by the statement of the firm that they are in use in the Royal Arsenals, the large armanent works, in hundreds of motor and engineering shops, and many of the Munitions Committees' factories.

The photographs include furnaces for annealing brass cartridge and shell cases, buttons, steel ingots, carbon and high-speed steel in bar, and for forging, hardening, re-heating, and other processes. The larger of the two illustrations reproduced here shows a standard low-pressure gas and air annealing furnace for annealing steel ingots, which form the basis for all projectiles and component parts of ammunition. This particular furnace takes charges of 5 tons. The second illustration is of a rotary gas-furnace used in the process of "nosing" the shells for the famous 75 m/m guns, though it is not necessarily confined to this size of shell. It is fitted with worm-gear, ball-race [upon which the "turret" revolves], and four-speed cone pulley; the speed being under the complete control of the operator. The turret is heated by means of a vertical gas and air blast burner. There are also other patterns of furnace for similar work.

Working under existing strenuous conditions, many factories have found it advisable to provide means for employees to take their meals on the premises; and here, again, both for cooking and water heating, the service which gas can render, by means of suitable apparatus, is inestimable. As an example, there is shown in the booklet the Richmond "Duplus" boiler—an appliance that is economical in working and simple in construction—capable of providing boiling water for up to 450 tea-cups.



Richmond Five-Ton Charge Furnace for Annealing Steel Ingots.

Rotary Furnace for "Nosing" Shells.

## NATURAL GAS ON THE CONTINENT.

The "Journal für Gasbeleuchtung" gave last month some particulars of the sources of natural gas which have recently been discovered and utilized on the Continent.

The article first referred to the extensive use of natural gas in the United States of America—especially in the Caddo Oil-Field to the north of Lake Charles. There are, however, prolific sources of natural gas in the oil districts of Caucasia, Galicia, and Roumania; and smaller supplies of natural gas occur in the vicinity of the Upper Bavarian Lakes, near Wels on the Danube, on the Island of Kokskär, on the coast of Esthonia, on the plains of Pisa, and at Lebrija, near Seville. The greatest source of natural gas in Europe, and perhaps in the whole world, was discovered in 1908 near the village of Kissármás, in Transylvania, which yields some 31,784,000 cubic feet of absolutely pure methane in twenty-four hours. The best-known source of natural gas in Germany is that of Neuengamme, near Bergedorf, which yields gas containing 91·6 per cent. of methane, 2·3 per cent. of hydrogen, and 0·8 per cent. of heavy hydrocarbons, with a residue consisting of carbon dioxide, oxygen, and nitrogen. This gas is piped to Hamburg, and mixed with the city gas supply. It is assumed that it is associated in its origin with the oil which is found on the Lüneburg Moor, though there is also a theory that the gas is due to blowers from a very deep-lying coal-seam. This natural gas has a calorific power of 900 B.Th.U. per cubic foot. It is also capable of being utilized as a source of valuable chemical products—such as formaldehyde, formic acid, and oxalic acid; though the utilization of natural gas in this way is only in its infancy.

Other sources of natural gas have been discovered accidentally in recent years in Germany. The Neuengamme natural gas was found in the course of boring for water for the supply of Hamburg. In the bogs of Oldenburg, natural gas has been used since the year 1906 for lighting and heating in a number of villages; the gas having been discovered accidentally through its escape, followed by ignition, from well water used for supply to boilers in a dairy. In some of the neighbouring districts of Holland similar village supplies of natural gas have been in use for several years; a gas dome being built over the water-tank, from which the gas is led to a gasholder. The gas in question contains about 74 per cent. of methane; and its calorific value is about 50 per cent. more than that of coal gas. The borings in Oldenburg are now nearly 100 feet in depth; while in Holland they are from 164 to 262 feet deep. The origin of the gas is not obvious, but it is found over a belt of country about fifteen miles in length and two miles in width, stretching from Oldebroek north-westwards to between Wilhelmshaven and Eckwarderhörn.

### War Changes in the Price of Gas in Germany.

The results of replies to a circular-letter of inquiry issued to German gas-works by the Central Gas Publicity Organization of Berlin have been tabulated and published in the "Journal für Gasbeleuchtung" of the 4th inst. They show the changes in the price of gas which have been made as a consequence of war conditions in various German towns. In nine towns there has been some reduction in the price charged for gas. In thirty-four towns a change has been made from differential prices for gas, according to whether it was used for lighting or cooking and heating purposes, to a uniform or flat-rate of charge for both purposes. The result is that in these towns gas used for lighting purposes is obtained at a lower rate than formerly; but it is impossible to say from the figures published whether the new system of charging involves an increase or a decrease in the average price for all the gas sold. In seventy-two towns there has been an increase in the price of gas varying from 1 to 3 pf. per cubic metre [from 3·4d. to 10·2d. per 1000 cubic feet]. The figures refer to changes made prior to May last.

**A Help to Meter-Readers.**—An idea which he has found to work well in his town [a purely residential one] has been adopted by Mr. Thomas Dann, the Manager of the Bedford Gas Company, as a result of seeing it mentioned in a description of American methods. It consists of a reply post-card which is addressed to consumers who may happen to be away from home when the inspector calls to read the meter; and it asks the consumer to kindly mark on the return half the position of the hands on the meter dials, and forward the card to the Company. This return half of the card has on it figured meter dials, with space beneath for the name and address of the consumer and the date; and the information when received, of course, saves the time which would be occupied by the inspector making a second visit to the premises.

# INTERNATIONAL GAS CONGRESS.

### Some of the Papers for this Week's Meeting.

The supplement to the "American Gas Institute News" received last week from New York contained as far as possible abstracts of the papers to be presented to the International Gas Congress, which is being held in San Francisco during this week, from Sept. 27 to Oct. 2.

First of all we may deal with the "Symposium" entitled "A Review of the Present Practices in the Manufacture and Distribution of Gas by British Undertakings"—that would have been introduced by the late Mr. Edward Allen, had his death not occurred to prevent. Four out of the five papers are summarized—that by Mr. John Bond, on "Carbonization," not being available at the time the supplement went to press. The remaining four papers are dealt with as follows.

## BRITISH PRACTICE IN THE CONDENSATION, WASHING, AND SCRUBBING OF COAL GAS.

By Dr. W. B. Davidson, late Engineer of the Nechells Works of the Birmingham Gas Department.

It cannot be said that general British practice in the condensation of coal gas is based on accepted scientific principles. It must be remembered that most installations were put into use more than thirty years ago, have been found to answer their purpose, and are still in so good a condition that their renewal is hardly warranted.

Opinion is divided regarding the respective merits of slow and rapid cooling of the crude gas. Practically all the older designs actually in use are built for the purpose of slow condensation. Feld's remarkable process of fractional condensation has apparently met with small success. The Klönne cooling tower is said to have met with great success in Germany. This consists of a cylindrical vessel in which the travel of the gas is slowed-down and the condensate drips down against the stream.

It is questionable if any system of carbonizing is quite immune from "stopped pipes." Ascension or "take-off" pipes vary in diameter from 6 to 8 inches. There is an objection to increasing the size of the pipe in that greater labour is required in augering. Water-drips are sometimes fitted to the middle of the H pipe—preventing the baking of the pitch deposited on the sides. Relief has been afforded by a system of heavier charges, and the period of distillation increased from six hours to 8, 10, or 12 hour work. The take-off pipes of continuous verticals do not give much trouble. The same cannot be said for intermittent verticals.

It is the general custom to maintain a liquor seal in hydraulic mains by allowing a supply of weak liquor to run in and overflow by a weir-valve. In some works, tar seal and tar circulation are in use. In comparatively few places, it is customary to work without a seal. The advantage accruing from this arrangement is the maintenance of a more uniform pressure in the retort—there being thus less risk of loss of gas through back-pressure, or dilution of the gas with nitrogen and carbon dioxide. Where "over-pulling" is indulged in, the pipes and hydraulic main become overheated, and tar gets converted into pitch or coke.

With modern vertical retorts or coke-ovens, pitch formation has to be provided for by rapid tar circulation, or by raking and fishing-out the lumps of pitch. Ammonium chloride has been found rather troublesome. When the gas is hot, this salt is carried along as fine crystals until the temperature is lowered to about 220° Fahr. Spraying of the affected spot with weak ammoniacal liquor has proved an effective remedy.

Many gas-works are provided with air condensers only, and have no auxiliary water condenser. Formerly with lower temperatures, naphthalene blockages were practically unknown. It is now not uncommon to find back-pressure owing to naphthalene. The Carpenter reversible condenser was designed to meet this difficulty. Most modern coal-gas works include a water-cooled condenser, of which the forerunner was the Morris and Cutler design.

In the condensation of carburetted water gas, the condenser takes the form of a cylindrical steel shell; the gas entering at the top and water at the bottom. Mr. C. Carpenter, D.Sc., has inaugurated a rapid and drastic condensation, from 140° to 50° Fahr. in one apparatus. The loss in the quality of the gas is quite insignificant.

The general practice is to employ a washer (such as the Livesey or the Pelouze and Audouin tar-extractor) for the removal of the last traces of tar, and the concentration of the ammoniacal liquor. The hydrocyanic acid is extracted immediately after the tar-extractor has done its work. The processes employed are the prussiate and sulphocyanide. The apparatus for this purpose is the Holmes brush-washer; but the ordinary Kirkham washer is also used. A few gas-works concentrating their liquor, sell the crystallized product; others sell their filtered liquor on the basis of prussiate and ammonia content.

In the sulphocyanide process employed for washing, the sulphur was introduced over the bays of the washer. The wrought-iron portions of the washers corroded away, however, and the extraction of cyanogen was, therefore, discontinued. The Williams modification of the process is now in operation in a good many gas-works. Ordinary purifier boxes are used; the sulphur being supplied by the spent oxide—granular, and not in powder form. Ammoniacal liquor is sprayed on the material to keep it active. The efficiency is frequently 100 per cent. The product is sold as a solution; the ammonia being about 30 oz. strength.

It is usual to recover from 2 to 2½ lbs. of prussiate of soda per ton of coal carbonized, against about 3 lbs. in the case of sulphocyanide. Cyanogen has been a welcome profit to gas undertakings. Its elimination, moreover, facilitates the removal of sulphuretted hydrogen.

Following the cyanogen washing, come the final ammonia washers. Of the more important types, the tower scrubber is still on many old-established works, the coke-filling of which has given place to wooden grids. The absorption of pressure is sometimes a serious matter.

To supply to the sulphate plant liquor of suitable strength, it is necessary to cool the gas to at least 70° Fahr. Naphthalene often gives rise to blockages in tower-scrubbers. Steaming is usually resorted to as a temporary remedy. The most satisfactory system of washing consists in the use of three sets—the first set for concentrating the liquor, the second and third sets working in series to provide the most intimate contact between the gas and the washing medium.

We have besides tower-scrubbers various designs of rotary horizontal washer-scrubbers—such as the "Chandler," "Creeke," "Eclipse," "Holmes," "Kirkham," "Whessoe," &c. The effectiveness depends largely on the absence of short-circuiting. In the Holmes brush washer the apparatus is divided into at least eight bays; liquor strength increasing from the gas outlet where water is run in to the gas inlet where strong liquor overflows.

Walker's purifying machine is vertical. The Feld type does not meet with much success; but others, such as the Kirkham, have found favour.

In the selection of a washer, one should provide a good margin in capacity, on account of the installation of new plant. The Pelouze and Audouin tar-separators, cyanogen washers, and naphthalene washers, have sometimes been erected, increasing the load on the exhausters to a serious extent.

Direct recovery of ammonia by washing with sulphuric acid has not yet made much headway. Reduction of the naphthalene by washing with creosote or anthracene oil or with water-gas tar, is practised in many places. The more usual method is to add middle oils to the gas in sufficient quantity to accompany the naphthalene. The solid hydrocarbon is thereby kept in solution. The amount to be evaporated varies from 10 to 20 gallons per million cubic feet. The apparatus is usually a Livesey washer, or two or three bays of a rotary washer. Spraying of oils into the gas has been practised, and a simple form of steam-heated vaporizer of naphthalene solvent has been brought into use with successful results.

## BRITISH PRACTICE IN THE PURIFICATION OF COAL GAS.

By J. Ferguson Bell, M.Inst.C.E., Engineer and Manager of the Derby Gas Company.

The purification of coal gas in closed vessels, by one of its so-called impurities (ammonia), is theoretically an ideal system, but so far has not fulfilled expectations.

The well-known F. C. Hills' process, which consists of heating crude ammoniacal liquor to within a few degrees of boiling point, was successfully used by the late Sir George Livesey, for several years, mainly for the removal of carbon dioxide. Hills' process was elaborated and modified by Claus, who ultimately succeeded in effecting the entire purification of coal gas in closed vessels, by combining the acid and alkaline impurities to form soluble salts. The Claus system of purification was tried at Birmingham by Mr. Charles Hunt, who erected an experimental plant in 1883. The results obtained were so promising, that the late Mr. James Stelfox, of Belfast, advised in 1886 the erection of a plant on the Claus system. After an extended trial, the process was discontinued. In consequence of uncertainty of action and loss of ammonia, the effective efficiency could not be relied upon to remove more than 60 per cent. of the total impurities.

Until recent years, lime was very generally used; but in consequence of the difficulty in disposal, and also the repeal by Parliament of sulphur restrictions (other than sulphuretted hydrogen), lime has been largely replaced by hydrated ferric oxide.

### Lime Purification.

The lime at first absorbs both carbon dioxide and hydrogen sulphide. Later, hydroxy-hydro-sulphide is decomposed, forming calcium carbonate, liberating hydrogen sulphide thus: The sulphuretted hydrogen being driven forward into a clean lime vessel forms sulphide of lime, which will absorb carbon bisulphide.

In the larger works, where the purifying plant is laid out for reduction of sulphur compounds by the lime process, are either separate vessels to remove each impurity, or sets of six purifiers—the first four being lime vessels, and the last two oxide. In either case special care is required to keep the calcium sulphide active to remove the carbon bisulphide. Otherwise the result is disastrous—the sulphur impurities may be increased instead of reduced. Under the best conditions, it was found that to supply gas with a 20-grain sulphur penalty limit proved so irksome that the sulphur restriction clauses in various gas companies Acts of Parliament were gradually repealed.

For efficient purification by lime, purifiers of small unit capacity, suited to the quantity of gas made, give the best results.

With a set of four purifiers, 32 feet by 16 feet by 4 ft. 6 in. deep, the writer continues to purify 1,000,000 to 1,250,000 cubic feet of gas per diem—removing the $CO_2$ and $SH_2$, and reducing the $CS_2$ to an average of 18 grains per 100 cubic feet—the impurities in the crude gas entering the purifiers being:

Carbonic acid ($CO_2$) . . . = 2½ to 3½ per cent. by volume.
Sulphuretted hydrogen ($SH_2$) = 700 to 1200 grammes per 100 cubic feet.
Sulphur compounds ($CS_2$) . = 30 to 70 grammes per cubic foot.

This lime-purified gas is mixed with that treated with oxide only, and so reduces the percentage of carbon dioxide and residual sulphur in the mixed gases.

### Oxide Purification.

The facility with which sulphuretted hydrogen ($SH_2$) can be removed from crude gas by the use of hydrated ferric oxide, and as residual sulphur in other forms is no longer compulsorily restricted, natural or artificially prepared hydrated oxide of iron is now very generally used in place of lime.

The purifying value of oxide depends not only upon the percentage of hydrated ferric oxide ($Fe_2O_3.H_2O$), but in addition on its physical and moisture contents. The author finds the addition of 1½ to 2 per cent. of air may be made to the second purifier of the series, without any noticeable reduction in candle power. This, with the daily reversal—the flow of the gas on the back-rotation system—lessens the number of changes by one-third. Revivification *in situ* may be conveniently effected.

Oxide purifiers often require to be changed, simply in consequence of excessive back-pressure. With "Milbel" grids, the surface area of the oxide exposed is doubled, and the weight of oxide in the purifier may be increased by 50 per cent. with reduced back-pressure.

In the larger works a horse-drawn plough is sometimes used for turning and breaking-up the oxide; but a much better plan is to use a mechanical breaker, of which there are several efficient types.

Weldon mud—a bye-product obtained in the manufacture of bleaching powder—was used, but its avidity to absorb carbonic acid and become inert to $H_2S$, together with its high first cost, prevented its extended use.

### Carbonic Acid ($CO_2$).

One per cent. by volume added, reduces the candle power by about 3½ per cent., the loss in candle feet being 2½ per cent. As the specific heat of carbon dioxide is high, its presence reduces the flame temperature by a greater degree than the percentage added, and the calorific value is reduced *pro ratâ*. It is, however, an economic question to be decided in each case, if the gain justifies the cost of its removal by lime.

### Sulphur Compounds ($CS_2$).

The residual sulphur, chiefly in the form of carbon bisulphide ($CS_2$) is a noxious impurity, and should be reduced, as the effect of this impurity when burnt is similar to that of sulphuretted hydrogen ($H_2S$).

The most notable advance in purification during recent years has been made by Mr. Charles Carpenter, D.Sc., in conjunction with Mr. E. V. Evans, the Chemist of the South Metropolitan Gas Company. The gas is pre-heated to a temperature of about 400° C.; then passed through externally heated tubes containing fire-clay balls impregnated with nickel salt, which, heated to a suitable temperature promotes catalytic action in the presence of hydrogen at a temperature of 450° C., and produces decomposition of the $CS_2$. By this process, the sulphur contents are reduced by 80 per cent. at a cost just under ½d. per 1000 cubic feet. The credit for successfully applying heat reaction to decompose $CS_2$ on a large working scale belongs to Hall and Papst, of the Portland Gas and Coke Company, Oregon, U.S.A.

Another promising process is that of M. Oscar Guillet, of Clermont Ferrand, France, in which the gas containing moisture is passed through oxide of iron heated to a temperature varying from 80° to about 200° C. The $CS_2$ is decomposed according to the well-known reaction: $CS_2 + 2H_2O = CO_2 + 2H_2S$.

### Purifying Plant.

For many years purifiers were constructed of cast iron, 4 to 6 feet in depth—with a water-lute cast on the side plate. The movable cover is constructed of thin steel plates, riveted to a trussed top framing. This type of purifier has of late been almost entirely discarded for the more compact luteless purifier, for which we are indebted to the late Mr. Henry Green, of Preston, who was the first to make this departure. It consists of a vessel formed of cast-iron plates, with one or more division plates to form separate boxes, the top being constructed of cast-iron plates, with suitable openings, having light steel movable covers, the gas-tight joint being made by an india-rubber pad.

If there is plenty of room, purifiers erected on the ground with oxide revivifying and storage sheds on each side is an economical structural arrangement.

When oxide is used as the purifying agent, it is usual to provide only two tiers; with lime purification, four tiers. All purifiers should be prepared for not less than four tiers, though intended for oxide purification, as conditions may so necessitate the use of lime or other purifying agent at some future time.

When new purifiers are erected, the approximate size of the inlet and outlet connections may be determined by the formula:

$d$ (diameter of connections in inches) $= \frac{1}{8}(L + B)$.
L and B = length and breadth of purifier in feet.

For many years hydraulic centre-valves were employed to operate purifiers. Dry-faced centre-valves have largely superseded the old hydraulic form of valve.

We are indebted to Weck for an original and decided advance in the construction and working of purifier valves. This ingenious valve consists of a combination of valves fitted in one body, and so arranged that they control the flow of gas to and from the purifiers—working one or more boxes in series.

The Pickering valve designed for the overhead type of luteless purifiers, and Milbourne's purifier valves for bolting on the inside of the purifiers, are both skilful adaptations of the Weck principle. The latter render the whole of the interior of purifiers available for purifying material.

The advances made in recent years in the construction and working of purifier valves have simplified and added to the reliability of the valves.

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## PRESENT PRACTICE OF GAS DISTRIBUTION BY BRITISH UNDERTAKINGS.

By Walter Hole, Superintendent of the Leeds Gas-Mains and Distribution Department.

In considering the present practice of gas distribution by British gas undertakings it may be well, for the sake of clearness, to divide this paper into a low-pressure and high-pressure section.

### Low Pressure.

There has been a very considerable change in the practice of distributing gas, for the reason that the fields of supply of most of the cities and towns have grown until they now cover an enormous area. As gasholders and all the etceteras of a storage station are expensive, it is a good thing that the introduction of high-pressure gas has made these unnecessary, except in the very largest areas.

Districting mainly takes two forms. Where the district lends itself readily to such a plan without too great duplication of mains and capital expenditure, the method of districting by altitudes is preferred. In cases where altitudes do not vary greatly, the plan of districting by separate geographical areas commends itself, as in this way districts which vary considerably in character may be governed separately. The industrial quarter, with its heavy day load, is thus treated according to its needs, without any necessary consideration of the other areas of a vastly different character whose requirements may vary widely.

A third plan (which may or may not be properly classed as districting), which is becoming increasingly adopted, is that of the belt-line main. As, however, such a main is generally used for the transmission of high-pressure gas, its purpose and usefulness may be more fittingly discussed in the high-pressure section of this paper.

The extent of the individual demand for gas, and the importance of carrying proper pressures so as to afford each consumer a fully adequate supply, is increasing. There appears to be no other plan of meeting all the complexities involved in maintaining a sufficiency of supply for all, with an over-plus for none, than that of maintaining a pressure in the mains sufficiently great to meet the highest demands, and to govern-down to others where necessary. The adoption of such a plan makes it imperative that the distribution system be so laid and improved as to resist successfully the increased tendency to leakage consequential on higher pressures.

The maintenance of considerably higher pressures on distribution mains will necessitate a considerable capital expenditure for service governors and for controlling the supply to consumers where pressures are much higher than necessary.

A considerable amount of pioneer work has been done in the line of automatic distance control of pressures; the points chosen for control being naturally those most disadvantageously situated from the point of view of supply. Three methods for effecting this purpose are in use—the simplest being the ringing of an electric bell in the governor-house when certain predetermined limits of pressure are exceeded at the point selected. A modification of this method allows a continuous indication of the distant pressures on a dial in the governor-house, combined with the ringing of a bell when certain points are reached. A third method attempts the completion of the whole process by not only signaling the pressures, but also automatically loading or unloading the station governors affected in accordance with the conditions obtaining from time to time.

The daytime consumption has now become such an important part of the output of most gas undertakings that much higher pressures are maintained throughout the hours of daylight than was formerly the case.

The main pipes in general use for ordinary purposes are of cast iron. The durability and adaptability of pipes of this material are beyond question; but the tremendous increase in roadway traffic places them at considerable disadvantage, due to their liability to fracture. A remedy for this trouble is being sought along three different lines: First, the laying of the smaller distributing mains under footpaths. Second, the provision of suitable subways in which the pipes may be berthed. Third, the use of steel mains, which by their own resilience will take-up and neutralize roadway vibrations.

With regard to the durability of steel mains, it is far too soon to speak with any degree of certainty, inasmuch as their introduction

for general use is so recent that no one can have had a very extended experience. A steel main was recently uncovered, which was laid in 1899, and was found in excellent condition.

Informed opinion is steadily tending to the substitution of heavier grades of pipes for those used when steel pipes first came into general use.

Both with cast-iron and steel mains the open socketed lead joint is in common use. Experiments have convinced the writer that the lead wool joint is of much greater strength than one of run lead; but it is a mistake to suppose that the greater strength is due to the greater density of the lead wool packing.

Experiments made on the crystallization of lead ring tend to show that the shrinkage of the lead ring toward the centre is one of the reasons for the essential inferiority of the run-lead ring as a jointing material.

Pneumatic caulking has not yet been introduced.

The rigid or telescopic joint has superseded the ordinary type of open socket joint for steel mains, which in turn appears likely to be eclipsed by the growing popularity of the welded joint.

Welded joints require more room than for making ordinary lead joints. Where long lengths of trench may be kept open, practically the whole of the jointing may be done above ground. The welded joints bring the ideal of a single continuous pipe from works to consumer within the range of practical politics.

The welded joint may be made in either one of two forms—the butt-weld or the telescopic socket weld. While it is admitted that a little of the strength and elasticity of the metal are sacrificed in a welded joint, experiments have shown that these changes are much less than has frequently been alleged.

Services are generally of wrought iron; and the economy of using only the heavier tubes is being increasingly recognized. In all cases wrought-iron pipes for services are given a good protective coating before being used. Malleable fittings are fairly extensively used; but the writer's experience is that they are less satisfactory than ordinary wrought-iron fittings.

A very considerable rise has taken place in the standard of public lighting due to the introduction of large unit lamps of both high and low pressure types, with the natural result that many of the principal thoroughfares are now very brilliantly lighted.

The development of automatic control has taken two principal forms—namely, clockwork and pressure wave. The best known types of the clockwork device are the "Gunfire" and "Horstmann;" and of the pressure wave, the "A. & M." and "Broadberry" are the most conspicuous examples. The experience of a full year's working with 250 A. & M. controllers shows 0·023 per cent. of failures per actuation, which result is confirmed by the writer's own experience.

In adopting any pressure-wave system it is necessary in a large undertaking to provide against the possibility of stocks being low, and consequent inability to give the necessary pressure wave by means of the holder alone. This is done in the City of Leeds by means of a motor-driven fan.

### High Pressure.

The question of high-pressure gas distribution has been before the British gas profession for a little more than ten years. For some time the early installations were small, tentative, and rather experimental. The demand for gas supply to sparsely peopled suburbs and out-districts has only been successfully and economically met by the provision of a high-pressure supply.

The term "high pressure" is construed as applicable to such pressures as are beyond the capacity of the gasholder to throw of itself, and which therefore requires the use of auxiliary apparatus. Accepting this definition, we may say that high-pressure gas is being used in this country to-day for four different purposes: 1. For the supply of storage holders at distributing stations. 2. For boosting the low-pressure system. 3. For direct supply to consumers. 4. For belt-line reinforcement of pressures.

The most common use to which high-pressure gas is put in this country is to boost-up or reinforce the supply at various suitable points in the ordinary low-pressure distributing system.

The flexibility of such a system is one of its most attractive features. Once suitably installed, it may be very largely extended, and the carrying capacity of the feeder mains may be greatly increased by working at high pressure. Another attractive feature is the economy possible by laying mains of smaller size.

Another form of boosting which is now coming into increasing favour is that in which a belt pipe-line girdles the whole area at some considerable distance from the centre, and is the means of introducing a reinforcement of supply into the mains on, or approaching, the outskirts of the area. By means of a continuous belt-line, pressures throughout the whole district may be maintained at any predetermined standard.

The various types of compressors used in this country may be classified under four heads. For the lower pressure of 15 to 20 inches head of water, fans of the Rateau or Sturtevant type, either motor or turbine driven. High-speed fans used when compressing gas to a pressure over 40 inches head of water. For moderate high-pressures, up to 5 lbs. per square inch, compressors of the rotary type are being generally used. For pressures over 5 lbs., reciprocating compressors of the Worthington or Ingersoll-Sargeant type give the most economical results.

The importance of the provision of efficient gas governors needs no emphasizing. Failure in this respect may lead to most deplorable results. Fortunately, there are governors on the market capable of doing most satisfactorily with exceedingly variable quantities of gas.

The difficulties of making the diaphragms and stuffing-boxes of dry meters strong enough to withstand heavy pressures have been successfully surmounted by the simple expedient of using geared inlet and outlet cocks.

The difficulty with regard to the porosity of the cast-iron cases of wet meters under high pressure has been overcome by the simple plan of filling up the pores with boiled linseed oil under pressure.

A number of meters of various types in which provision is made to give compensation for decreased volume due to compression, are in service, and have so far given satisfaction.

The application of high-pressure gas to customers direct is, of course, in its infancy at present in England. Some few undertakings in sparsely occupied districts are giving a high-pressure supply to consumers' premises, there to be governed down before passing through the meter. Great progress is being made in the provision of high-pressure gas-lighting for spacious interiors—such as covered-in markets. Another great field for the direct supply of high-pressure gas which is gradually becoming occupied is that of metallurgical operations of various kinds. High-pressure gas for public lighting is slowly, but none the less surely, impressing its merits upon our local authorities.

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## PRESENT PRACTICE IN THE SALE OF GAS IN THE UNITED KINGDOM.

By F. W. Goodenough, Controller of Gas Sales to the Gas Light and Coke Company.

Efficient salesmanship in the gas industry involves, I submit, the recognition of three facts:

(1) If you want every consumer to use as much gas as he can consume with profit or advantage to himself, you must make it easy for him to get an adequate and constant supply, and to get the most efficient appliances for its use. Then you must see that his appliances are kept constantly in efficient order.

(2) If you do not tell every consumer what you and your commodity are willing and able to do for him, he very likely will not know.

(3) If you want to consolidate your business on the surest foundation, you must get it fixed in the minds of every one of your employees that the consumers' interests and those of the business are parallel and not opposite; and your whole policy of dealing with the public—whether it be in giving advice, in rendering service, in receiving and dealing with complaints, or in settling disputes—must be based upon a conviction of this truth.

A policy founded upon these facts necessarily implies:

(*a*) The laying of adequate mains, the installation of capacious carcass pipes, and the maintenance of a good and steady pressure; the provision of slot meters for the poorer class of consumer; easy terms for the supply and fixing of apparatus; well-equipped show-rooms in suitable positions, staffed with trained salesmen and women; an efficient fittings staff; an equally efficient maintenance staff; reasonable maintenance terms.

(*b*) Effective publicity, including local, district, and national press advertising; expert canvassing; lectures, both domestic and scientific; good public and store front lighting.

(*c*) The provision and training of a good commercial and administrative staff imbued with the "spirit of the house" right down from the chairman of the board to the telephone operator, the office boy, and the doorkeeper.

The paper then treats under these headings: The laying of adequate mains; installation of capacious carcass pipes; maintenance of good and steady pressure; slot meters; supply of gas fittings and appliances; easy terms for the supply and fixing of fittings and apparatus; question of free loan and fixing; co-operation with the ironmonger; show-rooms; lady advisers; fittings and maintenance staff; maintenance of gas burners and apparatus; publicity; national publicity campaign; local publicity; personal publicity work; commercial and administrative staff.

In conclusion, the author said: If our review of what has been and what needs to be done leads us to a firmer conviction that, above all, our policy must be sound from top to bottom, broadly based upon the principle of efficient service, and to a clearer vision of how this policy may best be pursued, we shall have usefully spent our time, and will go forward to greater success than we have yet achieved.

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Among additions to the list of prohibited exports contained in an Order in Council dated the 16th inst. is gas carbon, the exportation of which is prohibited to all foreign countries in Europe and on the Mediterranean and Black Seas, other than France, Russia [except through Baltic ports], Italy, Spain, and Portugal.

Next Monday evening a paper will be read by Mr. Sydney G. Turner, before the Society of Engineers, on the subject of "Law and Engineering." He will contend that while there are many subjects of common interest to the lawyer and the engineer, there is no common meeting ground. The subjects he will deal with are: Expert evidence; the engineer as arbitrator; the engineer and engineering contracts; certificates; municipal engineering and law; problems of modern highway construction and traffic conditions; sewerage and drainage; private street works apportionments; gas, water, and electrical engineering; and the legal aspects of all these branches of engineering work.

## MODERN CARBONIZING SYSTEMS IN AMERICA.

Among the subjects down for consideration at Thursday's meeting of the International Gas Congress in San Francisco is a combined paper on the above subject contributed by the Society of Gas Engineering of New York City.

Introducing the paper, the authors said: Realizing the interest with which the members of the gas fraternity now regard the subject of carbonization, and appreciating the fact that such a paper would only be of value if the data were based upon actual working results, it was decided to corroborate and amplify such information as was already at hand by inviting the co operation of builders and operators of carbonizing systems of various types. In the preparation of the paper it was deemed advisable to make the comparisons upon a unit capacity of 2 million cubic feet of gas made per day.

With this in view, data sheets were sent to forty-four corporations representing builders and operators, with the request that the data be furnished, and where the plant from which the data were obtained had a capacity less or greater than 2 million cubic feet, allowances were to be made in order to place the data on a comparable basis. The object was to obtain reliable information from plants representative of systems now in operation, not estimates or probable improvements in results which might be made by building a new installation of a particular type.

Replies with complete data were obtained from nineteen sources, incomplete data from one, declinations from nineteen, and no reply from five. Plans and elevations of benches and retort-houses of practically all installations were furnished with the data. Among the nineteen complete reports, one includes the result of a thirty-day test of American coals in a foreign installation, and shows the effect of admitting a proportion of steam into the retort as compared with making straight coal gas. The data contained in the three reports were not obtained from operating plants, but were furnished by the manufacturers as characteristic of the results which could be obtained in the operation of their installations. The latter three reports, while of interest, have not been included in the final summary, and are not considered in the remarks upon the report as a whole.

For obvious reasons, it was necessary to regard all the information obtained as confidential, and each plant has, therefore, been designated in the report by a number and, for greater convenience in comparing the results from similar plants, the information has been grouped according to types, in the following order: Horizontals, Nos. 1 to 9; inclines, Nos. 10 to 13; intermittent and continuous verticals, Nos. 14 to 18; coke-ovens, No. 19. To facilitate the comparison of different systems, a table has been prepared, where the maximum and minimum figures of each of the different types of apparatus are given.

An analysis of the data contained in the tables affords the following information.

The area required for a horizontal retort-house of approximately 2 million cubic feet daily capacity varies from 9433 to 16,416 square feet. The area required is least where the charging machine operates from one side, and the greatest where the retorts are filled from both sides of the bench. The area required for an inclined retort-house of the same capacity is largely influenced by the length and cross-section of the retorts, and varies from 8848 to 10,871 square feet. The area required for a vertical retort-house depends also upon the dimensions of the retorts and the number of retorts per bench, and varies from 4800 to 6945 square feet.

The cubical contents of horizontal retort-houses varies from 392,490 to 872,000 cubic feet; of inclined retort-houses, from 491,164 to 578,212 cubic feet; and of vertical retort-houses, from 300,000 to 400,000 cubic feet.

The weight of refractory material required for horizontal settings varies from 3,396,000 to 6,119,000 lbs.; for inclined settings, from 5,356,400 to 6,690,400 lbs.; and for vertical settings, from 4,690,000 to 7,360,000 lbs.

The total weight of iron and steel in the horizontal settings varies from 372,000 to 737,938 lbs.; in the inclined settings, from 394,500 to 498,600 lbs.; and in the vertical settings, from 623,300 to 1,440,000 lbs.

The labour required to operate the retort-house for 24 hours varies from 125 to 266 hours for horizontals, from 147 to 200 hours for inclines, and from 57 to 106 hours for verticals.

In analyzing the charge per linear foot of retort, the type of machine and the cross-section of the retorts operated should be considered.

The candle-feet produced per pound of coal vary from 62 to 95 for horizontals; from 74 to 87 for inclines; and from 83 to 97 for verticals. Different types of burners were used for determining the candle power. For example, under Plant No. 2, it is recorded that a "Bray 'E. H.' 8-feet open flame tip" was used; for the Dessau plant, No. 14, a "Carpenter" burner; in other cases the Sugg "D" or Sugg "F" argand. As a result, the candle-feet depending upon these readings must be influenced by the method of testing, and are not comparable without an allowance for the type of burner used. Consideration should also be given to the probable effect of the grade of coal carbonized upon the candle power, the number of observations daily, and whether such observations were taken at regular intervals. Under Plant No. 12, candle-power observations were made only in the daytime and at 3½-hour intervals.

In comparing the B.Th.U. per cubic foot, there should be taken into consideration the yield per pound of coal and the quality of the coal from which the gas is produced, both of which will have an effect on the B.Th.U. per cubic foot and per pound of coal carbonized.

The tar recovered (in gallons) per net ton of coal varies for horizontals from 10·80 to 13·65; for inclines, from 11·06 to 13·29; and for verticals, from 14·40 to 15·15. The free carbon in the tar from horizontals and inclines averages over 24 per cent.; while that from verticals is less than 3 per cent.

The maximum ammonia recovered per net ton of coal for either horizontals or inclines is 5·80 lbs.; whereas for verticals the maximum ammonia recorded for a period of six months is 6·1 lbs. In a short duration test as high as 7·30 lbs. is claimed.

The furnace fuel used per 100 lbs. of coal carbonized averages 14·43 lbs. for horizontals; 12·32 lbs. for inclines; and 14 lbs. for verticals.

The low yield reported on one plant (No. 15) is said to be due to the fact that a certain proportion of the gas is used for heating the ovens.

Results based on periods extending over months or years should be considered as more reliable for comparison than those which are based merely on weekly or monthly periods.

### Conclusions.

Reviewing the advantages claimed for each system:

Horizontals generally are low in first cost, easy to operate, simple in heat control, readily accessible, and may be designed so as to compensate for expansion or contraction of the refractory material.

Inclines require no intricate mechanical stoking machinery; permit the use of comparatively inexperienced labour; are more flexible in labour operation—the number of men employed being dependent upon the number of benches in operation, and may be designed without difficulty to take care of expansion or contraction of the refractory material.

It is claimed that verticals, as compared with horizontals and inclines, may be built so that a smaller ground area is required, can be operated with less labour, that a greater quantity of coke, ammonia, and tar is produced, and that more uniform results, higher candle power, and heating values are obtained. In the case of continuous verticals there is an additional advantage in the abatement of the smoke nuisance. Some difficulty has been experienced in designing the settings so as to compensate for the expansion or contraction of the refractory material.

The summary concludes with these words: Owing to the reticence of operators of coke-oven plants, we have been unable to obtain sufficient information to warrant comparison of this type of apparatus with those included in this report.

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[The tables of figures referred to in the above *précis* were not available, in their complete form, at the time of its issue. We shall, however, take an early opportunity of publishing them in the "Journal."—Ed. J.G.L.]

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## SUBSTITUTING HEATING VALUE FOR CANDLE POWER AS A STANDARD.

By R. S. M'Bride, Associate Chemist, Bureau of Standards, Washington.

One of the three papers that, according to the programme, were to-day to occupy the attention of members attending the International Congress at San Francisco, was that written by Mr. R. S. M'Bride, of Washington, bearing the title "The Substitution of Heating Value for Candle Power as a Standard of Gas Quality."

In the abstract of the paper issued in anticipation of the meeting, the author pointed out that his object was to summarize the more important principles which must be recognized in the choice of a standard of gas quality, to point out some of the errors which must be avoided in making this choice, and to outline the most desirable methods for choice of standards or for substitution of a new standard for one now in force.

### Specification of Quality.

The principal specification of the quality of a gas supply should meet the following requirements:

1. It must be a real measure of the usefulness of the gas for the principal uses to which gas is put.
2. It must permit economical operation—including (*a*) use of the most economical fuels; (*b*) adoption of the most efficient processes for generation and distribution; and (*c*) operation with the minimum of financial risk.
3. It should be clear in all details, and should require only simple tests for its enforcement—*i.e.*, it should introduce no ambiguity in meaning and no uncertainty, difficulty, or undue expense for tests.

The community of interest underlying the proper relation of a gas company and its customers is of first importance, although

there is no doubt that far too many of the regulations now in force have been adopted without proper regard for this fact.

That requirement or standard of operation which permits the delivery of the largest amount of service for each unit of cost to the user, is obviously the best for the user and also the most desirable from the standpoint of the company, since it permits the company to secure its proper return and to maintain its property with the minimum of expense to the user of the gas.

As general principles, it must be borne in mind that the inducement to capital must be sufficient to bring it into the industry, and that progressive and efficient management must find greater reward than indifferent managements are allowed. But it must also be admitted that the advantages of improvements in the industry, of efficient management, and especially of growth of the industry through general and natural channels, must be shared with the public which offers to the companies the protection, the opportunities, and the facilities for operation as public service corporations. There is, or should be, a very real partnership, in which the public and the companies share in the rewards which follow from the growth of the business with generous patronage and good management.

In a majority of cases, only the results to be accomplished by the companies are prescribed; and the companies are permitted to bring about these results by any means which they may choose to employ. The operating engineer is generally in a much better position to determine the most economical methods of procedure in manufacture and distribution than is the technical staff of the regulation body. There are exceptional cases in which the authorities find it necessary to overrule the choice of the company, and prescribe methods as well as results, in order to protect the interests of the public from the prejudiced or incompetent decisions of company engineers. But fortunately these cases are rare.

In the ultimate analysis, it is desirable that there should be afforded:

1. Safety for the users of gas and the general public.
2. An adequate and continuous supply of gas at all times and for all parts of the territory which is, or should be, served by the company.
3. Proper maintenance of the producing plant and distributing system.
4. Fair return to the operating company.
5. Maximum service for each unit of cost to the user.
6. Intelligent conservation of the national or public wealth in the coal, oil, gas, and other natural resources of the country.

It is not proper to ignore any one of these six fundamentals; nor can any one of them, except the first (safety), be properly regarded as more important than the others. Indeed, each one is dependent for its accomplishments over any long period upon the successful accomplishment of all of the others; and it will be seen in the course of the following discussion, wherein each of these principles has an important bearing upon the choice of the standard for gas quality.

Estimates as to the percentage of gas which is used for various purposes can be made with some degree of certainty; but conditions of utilization are changing so rapidly that one should not place much dependence upon these figures. In any case, they are only of secondary interest, except for estimating the loss to the many users of open-flame gas-burners which may result from the diminution from the open-flame candle power of the gas; and for this purpose an approximate value suffices.

## Heating Value and Candle Power.

Apart from the matter of freedom from chemical impurities, the quality of gas is judged by its heating value and its open-flame candle power. Certain other criteria are also valuable in a consideration of the quality or the usefulness of the gas for special purposes; but up to the present time none of these have been specified in rules or laws prescribing the quality of the gas.

In considering the value of these two standards, one must regard each in its relation to the five principal applications of gas: (1) Open-flame lighting; (2) mantle lighting; (3) domestic cooking, water heating, and room heating; (4) industrial heating; (5) power production.

Summarizing the matter, it appears that the heating value of a gas is a direct measure of the usefulness for industrial heating and for domestic water heating, room heating, and cooking; also that it is not an exact measure of the value for mantle lighting and for power production, but is more significant for these items than is the candle power; and that the open-flame candle power is a significant property for open-flame lighting only. However, the fact should not be overlooked that a gas of good open-flame candle power necessarily has a good heating value; and thus maintenance of a candle-power standard offers a large measure of protection as to the heating value of the gas. It is largely because of this fact that candle-power standards have so long remained in force.

The changes in requirements, as well as in methods of enforcement of regulations as to gas quality, have been very rapid in the past few years. For example, as short a time as five years ago, there was only one State in which there was a State Commission rule or State law in force prescribing a limit on the heating value of gas. At the present time there are thirteen regulations of this nature in force over whole States, and four other sets of rules are pending in which similar requirements are included. As the number of State Public Utility Commissions is increasing each year, it is not unlikely that within five years there will be some requirements as to heating value of gas for the majority of the States.

There is no special need for discussing further in this paper the principal reasons why it is now generally believed that a heating value standard is of greater value and significance than is a candle-power requirement. It is generally accepted without question that the heating value is a better measure of the general usefulness of the gas. It is important, also, to bear in mind the advantage to the gas maker of the heating standard, because of both the greater ease of regular operation to meet a heat-unit standard and the smaller percentage loss in heating value during pumping or distribution of the gas.

The tests of heating value, both for works control and for official inspection, can be made with greater accuracy than can tests of candle power. The uncertainties accompanying the enforcement of such rules are therefore a minimum. This is due not only to the accuracy of testing which is possible, but also to the exactness of the definition of the heating value. This property of the gas is a specific one, determined only by the character of the gas. It is not, as is the candle power, primarily dependent upon the character and condition of the burner used in the test, the atmospheric conditions, and other factors—many of which cannot be controlled or corrected for.

## Selection of a Heating Value Standard.

The problem of selecting a proper standard for the heating value of gas is primarily an economic one. In its simplest form, the selection of a heating value standard would be one in which it is only necessary to determine for each of several qualities of gas the proper average price to the customer, and then to select that quality which permits delivery of the most heat for each dollar of cost to him. For example, we can assume a certain quality of gas and certain values for each of the principal items which go to make up the total charge to the customer, and from these compute the number of heat units which the customer would receive for a dollar. Then applying the same calculations to costs for other quality of gas, the relative value is made clear. An illustration of this method is given by the Bureau of Standards in its Circular No. 32.*

If full data were available for any given city and there were no complicating conditions to influence the decision in the case, it would be a fairly easy matter to adjust the standard for any special case to correspond with the local conditions. However, there are many factors which are of great importance in reaching such a decision; and it is the consideration of these special factors to which the greatest attention must be given.

## Methods of Manufacture and Local Conditions.

The character of coals available in any locality is a very important factor in determining the quality of the gas which can properly be required. Indeed, the choice of methods of manufacture and of sources of coal are determined by the standard which is fixed for the quality of the gas in many cases. This is proper only if it is evident that this choice is the one which is likely to ensure to the user of the gas the most service for each dollar of cost.

In some cases where coal gas is to be made, cutting down the yield of gas per pound of coal would make it possible to comply with a standard which required production of a high heating value or high candle power. Some engineers urge that it is never justifiable to require so high a value as to make this necessary; but this is probably too sweeping a statement. Complete gasification of a coal is often desirable, in order to produce a coke very low in volatile matter. When considering such cases, however, the relative net gasholder cost per heat unit is not the only factor to be taken into account. [An example illustrating this point is given in the full paper.]

Summarizing the important points in reference to the coal supply, one finds that the standard should conform to the following conditions:

1. Not be so severe as to prevent a choice of the most economical processes of gas making.
2. Permit the use of the most economical coal available on the local market.
3. Be such as to allow operation to get reasonable yields of gas per pound of coal, and permit the manufacture of a quality of coke suited to the local market, if coal gas is made.

If a standard were to be fixed for a locality in which there was no gas plant, there would be no need to consider the advantages of one type of plant as compared with another, except from the standpoint of minimum total cost of production. However, in a majority of places standards which are adopted effect the operation of a plant already in use, and it is necessary to have the standard so adjusted that it will not necessitate the abandonment of a plant which is in a condition to operate efficiently.

The depreciated condition of a plant will in some cases also be a factor in influencing gas quality requirements. Lack of repairs and replacements will, however, seldom be an important factor except for short periods.

In any locality where especially favourable markets for coke, tar, benzol, or other bye-products are found, the advantages in low net gasholder cost with one style of plant and system of operation are often large enough to far overshadow any disadvantage

* See "JOURNAL," Vol. CXVIII., pp. 501, 576, 634.

in lower standard or large plant investment. In such cases the simplest form of cost comparison, like the illustrations given in the earlier sections of the paper, reveals the most economical conditions of operations.

Gas when subjected to low temperature, to high pressure, or to "friction," loses certain constituents which are particularly valuable in contributing to the heating and lighting value of the gas. It is, of course, necessary to take account of these distribution losses in fixing standards which apply to gas reaching the customers' premises. But it has been found that the changes in heating value of the gas which occur are a much smaller percentage of the total than the losses in candle power that occur simultaneously. This is due to the fact that the hydrocarbons which condense from the gas contribute more to the lighting than to the heating value of the gas. The losses in heating value rarely exceed 5 to 8 per cent. of the total; and the candle-power losses are often several times these percentages.

The considerable value to the user of gas of uniformity in supply is sufficient in some cases to recommend one standard as preferable to another. However, the uniformity possible is rarely greater enough in one case than in another to be a deciding factor for any value up to 630 (even higher) B.Th.U. per cubic foot.

### Testing for Quality as Delivered to the User.

The tests of gas quality should be made at points which will ensure results representative of the quality of gas actually delivered to the users. Tests made at the manufacturing works are of value; but they do not serve to detect deficiencies in quality which result from loss in heating value during supply, because of improper operation during the condensing of the gas. If tests at the works are to be used as the principal basis of control, it is desirable they should be supplemented from time to time by tests made at some distance from the works, so as to determine that the quality of the gas does not deteriorate unduly *en route* to the users.

In some State regulations, allowance is made for losses during compression and pumping of gas at high pressure. It is doubtful, however, whether there is any need for so large a tolerance in this particular as is sometimes made. It would rarely be necessary to allow more than a 25 B.Th.U. tolerance for compression and pumping of gas under ordinary conditions in the United States. To fix a requirement which would prevent such high pressure distributions is very undesirable. But the tolerance allowed in heating value per cubic foot should not be made so great as to permit gas of unnecessarily low quality being supplied at the distant points. If the gas before compression is well condensed, and then meets the general heating value standards, reasonable allowance to provide for necessary decreases during compression should be made.

### Charging for Gas.

A very large part of the total cost of gas to the user is made up by charges which are more or less constant per year. In computing costs per 1000 cubic feet or costs per 1,000,000 B.Th.U., it is of great importance, therefore, to know what will be the total sales either in cubic feet or in B.Th.U., as the case may be. This subject has been discussed at great length on numerous occasions; but for the present it is sufficient to summarize the three principal conclusions which can be regarded as reasonably well established.

1. For most computations, it is safe to assume that the total heat required per year for present users of gas will be little changed by a change in price of gas.
2. Many users of small amounts of gas per month will tend to use gas to about a fixed cost per month regardless of the quality or price per 1000 cubic feet.
3. Although in the industrial use of gas there is a tendency toward a constant number of heat units employed each year regardless of quality, yet decreases in cost per heat unit make possible new applications for gas, and thus largely affect sales.

There are two special methods of charging for gas, other than the flat-rate per 1000 cubic feet, that are of interest in consideration of standards for quality. One system is that which has been proposed for adoption in a number of cities, whereby the charge for gas would be based solely upon the heat furnished—that is to say, the charge would be fixed per 1,000,000 B.Th.U., and not per 1000 cubic feet of gas. Obviously, there is no need to specify the quality of the gas which is supplied when this system of charging is adopted, except to ensure that the quality of gas supplied will be a reasonably useful and uniform one.

Another system of charging (of some interest in this connection) is that general group of rate schedules in which there is fixed for each customer a so-called consumer's charge and a demand charge, which are made to cover expense items that are dependent upon the number of customers or the customers' "demand," but independent of the quantity of gas used. In some rate schedules, these two charges are combined in a single charge per customer, which is graduated according to the customer's "demand." Of course, in any system of charging, there is a charge for the gas itself made according to the quantity of gas used. But this charge makes up only part of the bill, and for any small customer it is only a small part. In a number of cases engineers have argued from this fact that it is by no means as important to control accurately the quality of the gas as would otherwise be necessary. However, this conclusion is by no means justified. The average number of heat units which can be delivered to the customer for each dollar of total cost to the customer is the best measure of the efficiency of the system. It is therefore necessary to control the heat delivered to the customer under such a system of rates as accurately as under any other system. Otherwise, the rate to the small user and to the large user will not be properly distributed; and one class of customers or another will suffer unless the rate for the gas is fixed properly to correspond, for each class of customers, to the actual cost for the quality supplied.

### Uniformity of Supply.

Obviously, it is very important that gas-using appliances give satisfactory operation at all times, with no great amount of attention on the part of the customer; since the majority of the customers of a company cannot be expected to adjust their appliances to meet any new condition of gas supply. To a greater or less extent the users of gas on an industrial scale can and will make such adjustments; but the domestic utilization of gas is ordinarily dependent upon such uniformity of supply as will permit satisfactory operation without adjustment of the appliances or fixtures.

There are four factors which very largely affect the safety, efficiency, cleanliness, and convenience of a gas-consuming appliance in the respects above referred to. They are: (1) The heating value per cubic foot; (2) the volume of air required for the combustion of a cubic foot of gas; (3) the pressure of the gas supply; (4) the density of the gas. The pressure can, of course, be regulated independently of the other three. But these other three are largely interdependent; and it is doubtful whether it is practicable to undertake to control all of the three properties at the same time.

It is only possible to control all of these factors to produce the ideal condition by very elaborate precautions. However, the general effect of each of the conditions is known; and changes which would otherwise be detrimental to the service could in some cases be cared for by changes in the other conditions of supply, thus tending to compensate for the influence of the first change.

It is, of course, necessary in making the change from one condition of supply to another, to bring about this change with such precautions that the customers will have reasonable opportunity for adjusting their conditions of use to the new conditions of supply. In a later part of the paper is discussed the importance of assistance to the customers at the time of change from one supply to another.

### Adopting a Heating Value Standard.

In the adoption of a heating value standard, whether it supersedes a candle-power standard or whether it be adopted as an entirely new specification for gas quality, it is important to know what the quality of gas has been in the past. If it is found that the heating value of the gas which has been supplied in the past is not known, there is no material advantage in immediately proceeding to adopt a heating value standard. It would be better to proceed at once to determine what the quality of the gas then being supplied actually is, so that an intelligent comparison can be made. It is then possible to determine what is to be gained by a change in one direction or another, and to make at least an approximate estimate of relative costs for gas of the different qualities.

Although it is impossible to judge for every case what has been the relation of heating value standards recently adopted to the heating value of the gas previous to the enforcement of these requirements, it seems to have generally been the case that the new standard has permitted a decrease in the heating value furnished. For some small cities improvement in quality may have been made necessary. But usually there is very little evidence for such small cities; and the estimates which have been made to this effect are therefore of doubtful accuracy.

### Requirements of State Commissions.

It is generally proper that, when a heating value standard is adopted, it should require gas of at least as good quality as was formerly furnished, unless there be some concession in price or evident need for increase in the return to the company. Two State Commissions have attempted to accomplish this by the adoption of a requirement that, in the case of any companies supplying a heating value above that which is required by the standard adopted, the quality must not be reduced below that formerly supplied without permission from the Commission, and without consideration of the reasonableness of changing the price of the gas to correspond to the new quality. In adopting the heating value standard of 565 B.Th.U. per cubic foot for Illinois, the Public Service Commission of that State made such requirement; and in connection with a standard of 575 B.Th.U. per cubic foot for Connecticut, the Public Service Commission of that State has fixed a similar regulation.

There is, however, one difficulty involved in the adoption of such a rule as that just referred to, since usually when the requirement is in this form, it fixes a standard much below the average formerly supplied, and thus unnecessarily encourages a general reduction of the heating value per cubic foot of gas. Unless it is established more clearly than it yet appears to have been, that a heating value materially below 600 B.Th.U. has an economic advantage, there is no need to change the present general practice. It would seem to be rational when fixing a standard for a whole State to establish

a requirement at a figure which is approximately equal to the quality of gas supplied in a majority of the plants which are operating in a satisfactory manner and giving good service. Then, if it is found that some plants are unable to maintain this general average, it is quite proper to afford relief to such companies by special action—permitting them to supply a lower quality than that fixed by the general requirement, and to fix a special price for this quality. It is hardly proper to assume (as sometimes appears to have been done) that the standard must be fixed so that the poorest plant will, at the time of greatest difficulty, be able to meet the standard. To be really a standard for service in the proper sense, the requirements should be such as will ensure gas of good quality from all companies, with tolerances properly arranged to permit the necessary variations below the average required, either for single months, for single days, or for companies operating under peculiar conditions.

Although a candle-power requirement is no longer the best standard to be fixed for the quality of gas, it is nevertheless true that a good candle-power ensures to the user a gas of good quality, whether it be used for lighting, heating, or other purpose. When such candle-power requirement is superseded by a heating value standard, the problem is to find what heating value has been maintained in the past, and to make comparison between the heating value which has been supplied and that which it is proposed to supply. Whether the heating-value standard should then be supplemented by a secondary candle-power standard may also be a question of importance.

### Readjustment of Gas Appliances.

If changes in the character of gas make necessary readjustments in the gas appliances, the company will, of course, stand ready to assist its customers in securing satisfactory arrangements for use of the new gas. And if a gas very low in open-flame candle power is to be substituted for one of high candle power, it is necessary also to consider means for the elimination of such open-flame lighting as cannot be satisfactorily continued under the new conditions. The object to be sought is the adjustment of conditions to a state where each customer will, with the new quality of the gas, be at least as well served as formerly; and if there is some advantage resulting to the companies from the change, the customers should share in the advantage by securing better service or cheaper rates.

In this connection, the very important influence of public opinion may be suggested. If changes apparently detrimental to the quality of service are made, the loss to the company because of unfavourable public opinion is often serious; since it may result both in decrease in sales and increase in expense for handling complaints. The public is often prejudiced because of its incomplete understanding of the facts. It is important, therefore, that a full statement of the facts be made to customers affected by a change, in order to make clear to them the mutual advantage which is expected from the readjustment of conditions.

Obviously, the proper standard for gas quality in any given case is closely related to the rates charged for the service. Indeed, more and more it is being recognized that, in the adoption of a particular heating value, it is necessary to consider the question of relative costs and relative rates to the public. It is, of course, unnecessary that the consideration of costs and rates be carried out in such minute detail in the course of adoption of standards for service as would be necessary in cases where the rate to be fixed was the primary object of the investigation. However, the relative costs should be known with reasonable accuracy, in order that the economic considerations may be properly taken into account.

## WATER-GAS MANUFACTURE IN THE UNITED STATES.

This question formed the subject of two papers which (according to the programme) are being read to-day at the San Francisco Gas Congress. The first one was entitled:

### HISTORY OF THE DEVELOPMENT OF WATER GAS.

By O. B. Evans.

A very brief sketch of the early history of water gas is first of all given; and the paper then describes and illustrates the retort form of apparatus. In this type, water gas is made by the passing of steam through coal contained in externally heated retorts. Naphtha is generally used for enriching and is sometimes admitted with the steam before it comes in contact with the coal, and sometimes mixed with the blue gas and thereafter fixed by passing through another retort. The heat requirements of such a process are discussed, and reasons are advanced indicating why it had to give way to the later forms.

In the generator-retort systems which followed, non-luminous water gas is made in one vessel from carbon heated by internal combustion, and later carburetted. Several types are described, and the fundamental objections to them are stated to be:

(1) They are not economical in fuel consumption.
(2) Their capacity is small.
(3) The fixing surface is small for a given volume of apparatus.
(4) They are generally designed for the use of naphtha, and are not well adapted to use the heavier oils of to-day.

The development of the Lowe system is traced from the original plant erected in 1874 to the modern type. The advantages and disadvantages of the various changes in design are pointed out, and reasons are given for the survival of those which have stood the test of time.

The desirability of being able to use soft coal is stated, and some general remarks are made upon the behaviour of bituminous coal when used in water-gas apparatus. Briefly, it melts and forms a blanket on the top of the fire, which prevents the uniform flow of air. Descriptions and illustrations are given of the Fahnehjelm, the Rose-Hastings, and the Rew appliances, and some of the reasons are pointed out for their failure to compete successfully with the present type of apparatus which uses a more expensive fuel.

Some of the principles of water-gas manufacture are next gone into rather fully, in the "hope that the recognition of such principles may assist in determining the possible chances of success of any proposed modification."

The subject of oil treatment is then discussed at some length, and reasons are advanced showing why the fractional treatment of oil which would seem to offer such a field for improvement in efficiency may really have but little to recommend it. The effect of "fixing" an oil in the presence of the hydrogen of blue gas is stated to be very desirable, and is given as one of the probable reasons for the abandonment of the oil-heater.

The effect of up-and-down runs and blows, and the rate of blasting, upon the efficiency and capacity of a set, is discussed; and it is stated that capacity is a function of the rate of blasting, and that this in turn is limited (among other things) by the ability to prevent dust from blowing over into the carburettor.

Some attempts to eliminate the hand-cleaning of generator fires by the return of combustion products beneath the grate and by melting the clinker and running it off as slag, are described; and the action of a generator fire in relation to the clinker problem is explained. A theory is advanced to account for the lack of success of many of the mechanical grates which have been tried. The automatic operation of water-gas sets, as developed by Mr. C. F. Zeek, at Pensacola, Fla., is briefly mentioned.

The difference in the view of the gas manager toward residuals between the early days of the industry and the present is fully brought out. Figures are quoted showing the increase in operating efficiency between one of the earliest generator-retort processes, in which the fuel consumption amounts to about 140 lbs. of coke per thousand, the Lowe process of about 1889, which consumed from 45 to 50 lbs., and the modern apparatus. The further possible theoretical saving is calculated, and a suggestion is made that by preheating the steam and air it might be practicable to reduce considerably the present consumption of raw materials employed.

### BLUE WATER-GAS AND DEEP-FUEL COMBUSTION.

By A. G. Glasgow.

Economy in the manufacture of water-gas largely depends, the author points out, upon the efficient application of the principles of deep-fuel combustion to the operation of air-blasting. Oxygen and carbon, under different conditions, combine in different proportions to form two different gases. In the presence of sufficient oxygen, burning carbon saturates itself with two atomic portions of oxygen in order to form the product of complete combustion—carbon dioxide ($CO_2$). This may be called the "First Law of Combustion."

Where the supply of oxygen is insufficient to saturate the burning carbon, this "excess" carbon will partially satisfy its affinity for oxygen by combining with one atomic portion of oxygen to form the product of incomplete combustion—carbon monoxide (CO). This may be called the "Second Law of Combustion," and operates as follows: The affinity of highly heated carbon for this first atom of oxygen is such that, in the absence of free oxygen, it will rob saturated carbon (in the primary form of $CO_2$) of one of its atoms of oxygen—thus, $CO_2 + C = 2CO$.

This half-saturated carbon (in the form of carbon monoxide) is still combustible, and will combine with a further atom of oxygen to form the saturated product of complete combustion, carbon dioxide—thus, $CO + O = CO_2$. This may be called the "Third Law of Combustion."

### Deep-Fuel Combustion in Gas Manufacture.

As commercially applied to gas manufacture, deep-fuel combustion may be generally classified under four heads:

First: The continuous manufacture of industrial, Siemens, or generator gas, where incomplete combustion products are used as a vehicle to convey the energy of the fuel to some point of useful application outside the generator. In the economical application of this process, the temperature of the fuel-bed is of no direct account. The sole requirement is that the blast gases (or more correctly speaking, the "draught gases") shall contain the maximum amount of available energy for the minimum consumption of fuel. Inasmuch as the sensible heat of these "draught gases" is largely lost or inapplicable, this means that they must contain the maximum of potential energy—*i.e.*, the maximum of combustible CO. To this end, in the manufacture of industrial Siemens or generator gas, the air supply must be carefully restricted, and the height and temperature of the fuel-bed are regulated, in order to produce partial or incomplete combustion (*i.e.*, combustion with

the oxygen of the air to CO) as the ultimate result, and to minimize the unreduced $CO_2$ in the gas.

Second: With certain fuels, however—such as anthracite coal or coke—this incomplete combustion with the oxygen of the air to CO may be effected at such a rate as greatly to overheat the fuel-bed. This facility is utilized to make, instead of Siemens gas, a special and stronger mixture commonly distinguished as Dowson or producer gas. Producer gas is the result of admitting (often as an injector for the air) a quantity of steam, so proportioned to the volume of air that the desired temperature is maintained in the fuel-bed by a proper balance between the heat generated by the incomplete combustion with the oxygen of the air to CO, and the heat absorbed by the decomposition of the steam to $H_2$ and CO. The result is, therefore, a corresponding mixture of Siemens gas and water gas, made continuously.

Third: The intermittent manufacture of water gas, where the gas-making operation is frequently intermitted for a recuperating air-blast, designed to restore to the fuel-bed the heat which has been previously extracted in decomposing the steam into water gas ($H_2 + CO$). In this simple blue water gas manufacture, the character of the blast products is of no direct account, as they have no duty to perform. The sole requirement is that the air-blast shall restore to the fuel-bed the necessary quantity of properly distributed heat, with the minimum consumption of fuel and time. This means, of course, that these blast products should not carry away unconsumed fuel.

Fourth: A "combination" process, whereby any desired proportion of the heat energy developed during the air-blast period is conveyed by the blast products to an extraneous point of application, while the remainder of such heat energy is stored in the fuel-bed for the subsequent decomposition of steam into $H_2$ and CO. The two examples given of this combination process are: (*a*) The carburetted water-gas process; (*b*) the self-steaming blue water-gas process.

## EXPLANATION OF TECHNICAL LIGHTING TERMS.

A very useful section of the report (recently issued) of the Departmental Committee on Lighting in Factories and Workshops is one in which the technical terms ordinarily used by illuminating engineers are fully explained. It will be well, therefore, if this particular portion of the report is reproduced (practically *in extenso*), although considerations of space forbid the like treatment of all the rest of the voluminous report.

The Committee say: A surface appears to the eye to be illuminated because of its capacity for reflecting and diffusing light which reaches it by variation from the various sources in its neighbourhood. Such sources may be artificial (*e.g.*, gas-lamps) or natural (*e.g.*, white clouds of the sun).

A clear distinction must be drawn between "illumination" and "surface brightness." Briefly expressed, illumination is measured by the amount of light received on the surface of an object from surrounding sources; while surface brightness is measured by the amount of light returned from the surface. In the case of non-luminous bodies, the surface brightness is always less than the illumination; for no surface returns again all the light which falls on it. If we have three different surfaces, each exposed to its own light source, we can adjust the sources to give equal illumination at each surface. The surfaces will not generally look equally bright; for the amount of light each returns to the eye of the observer will differ. In other words, each has a different surface brightness. On the other hand, we can adjust the sources so that all three surfaces look equally bright, and each will then have the same surface brightness. In this case, the illumination at each surface will be different. White cardboard returns nearly all the light falling on it, so that under a high illumination it will have a high surface brightness; a black floor or foundry sand returns only a small percentage of the incident light, and under similar conditions its surface brightness will be low.

### Illumination.

The illumination at any surface is proportional to the amount of light incident on it; and when we speak of the "illumination" at a point of a surface, we mean the amount of light which falls on a unit of area of the surface adjacent to the point. This can readily be measured by means of illumination photometers, of which there are several portable types at the present time.*

The illumination at a surface depends not merely on the strength or candle power of the source of light to which the illumination is due, but also upon the distance of the source from the surface. Thus, apart from reflection from surrounding bodies, a light-source of one candle placed at a distance of 2 feet from a surface produces at that surface only one-fourth of the illumination it would give if the distance were reduced to 1 foot. Again, the amount of light from a given source which falls on any portion of a surface depends both on the distance of the surface from the source and on the angle at which the light rays strike the surface. If the part of the surface considered is placed at right angles to the direction of the light, a maximum number of rays will meet it; and its illumination, therefore, will be greater than if placed in any other position so that the light rays strike it obliquely. Hence in the consideration of the illumination in any room, it is not correct (as has sometimes been the practice) to take as a criterion the total candle power of the sources of light, or the candle power per square foot of floor area or per cubic foot of total volume, for all such methods leave out of account the effect of the distance of the light sources from the benches or floors which require to be illuminated. We consider, therefore, that the only rational criterion of the adequacy of the lighting is the actual illumination at the place, for instance, where work is being carried out, or in the case of gangways and passages, at the floors over which people are liable to pass.

The now-accepted unit of illumination in this country is the "foot-candle."* One foot-candle may be defined as the illumination produced by a light source of one standard candle at a point of a surface 1 foot from the source, and so placed that the light rays from the source strike the surface at right angles.

Thus if a source of one candle be placed at a height of 1 foot above a horizontal table, the illumination at the point of the table vertically below the source is one foot-candle. Similarly, with a source of 50 candles at a distance of 1 foot, the illumination is 50 foot-candles; while if the distance is increased to 10 feet (since the illumination is inversely proportional to the square of the distance from the source), the illumination at the point on the table vertically below the lamp will be 50/100, or 0·5 foot-candle. If the point on the table is not vertically below the source, the obliquity at which the light is incident must be taken into account, and the calculation is less simple, but the illumination can still be expressed in foot-candles. As already mentioned, however, illumination can always be measured directly by means of suitable instruments without recourse to calculation.

### Surface Brightness.

We see a body by means of the light which reaches the eye from its surface. If the surface is self-luminous, the light is due to the body itself; and the apparent brightness of the body depends on the intensity of the actions to which the luminosity is due. This is the case in a gas-flame or in the filament of an electric lamp. If the body is not self-luminous, its brightness depends on the nature and colour of its surface, and on the amount of light falling on it. The light by which an observer sees the body comes from the source which is illuminating the body and is reflected by the body to the observer. Some portion of the light is reflected regularly according to the laws of reflection, and its amount will depend on the angle at which the incident light falls on the body. But unless the surface of the body is polished, the larger portion of the light is diffused by the surface—being reflected in all directions. It is with this diffused light that we are mainly concerned in the case of vision. The amount of light reaching the eye from a given area of an illuminated surface depends upon the nature of the surface, the angle at which it is viewed, and the amount and direction of incidence of the light by which it is illuminated. We may imagine the luminosity of the surface to be due to a number of sources of light, each of definite candle power, so distributed over the surface as to secure that the proper amount of light travels in the direction in question from each unit of area. We may thus measure surface brightness in candles per unit area. Again, the apparent size of any portion of a surface depends on the angle at which it is viewed. In estimating the relative brightness of different parts of the surface, the eye does not compare the amounts of light coming from equal areas, but the amounts which come from areas which appear equal—from areas, that is to say, whose projections at right angles to the line of vision are equal. It is convenient, therefore, to define brightness with reference to these projected areas, and to say that the amount of light travelling in a given direction from an area of the surface whose projection at right angles to the line of vision is unity, measures the surface brightness estimated in that direction.

The quantity of light returned from any surface depends, as already stated, on various conditions. An ideally white surface is one that returns all the light falling on it. The brightness of such a surface would be numerically equal to its illumination, which is measured in foot-candles. Thus surface brightness, like illumination, may be expressed in foot-candles, and is then measured by the illumination at an ideally white surface just matching in brightness the surface under consideration. In the estimation of the illumination requisite for any given work, the nature of the surface on which the work is being done is, therefore, an important factor.

A surface appears coloured when it returns some rays of the spectrum more copiously than others. Thus a red surface is one which absorbs most of the rays except the red, and allows a preponderance of the latter to reach the eye. Such a surface behaves very differently to red and to blue light; but the distinction between illumination and surface brightness still remains.

### Glare.

The term "glare" is often used to indicate the serious effects on the eye of an intensely incandescent body, such as the sun or molten metal, but is now very generally applied to a class of phenomena in which light from bright sources or objects enters the eye in such a manner as to cause annoyance, headache, and other

* As shown in Appendix XVII., the accuracy with which illumination measurements can be made with properly constructed and calibrated portable photometers is of the order of *plus* or *minus* 5 per cent. An allowance of *plus* or *minus* 10 per cent. should afford sufficient margin to cover the instrumental errors of such apparatus.

* The "foot candle" is the unit generally employed in this country. On the Continent of Europe the "metre-candle," with a value roughly of one-tenth of a foot-candle, is used almost exclusively.

trouble, and often, eventually, diminished ability to see. The word "glare" is used to cover any of the following phenomena:

(1) The effect of looking directly at a bright source of light—such as an arc lamp—so that the observer is for the time being prevented from seeing other objects properly. He is temporarily dazzled, and his vision is impaired for a short period after the light ceases to enter his eyes.

(2) The effect which is produced by the presence of one or more bright sources of light towards the edge of the field of vision so that the rays enter the eye obliquely from them. An observer may never look directly at such sources of light, but he is nevertheless troubled by their presence near to the object at which he is looking. This is the commonest form of glare.

[Both these forms of glare (1) and (2) are directly attributable to the presence of unshaded sources of light.]

(3) The effect which is produced when the surface of cloth, metal, paper, or other material being worked upon is shiny or polished, and reflects light directly from some source into the eyes of the worker. Many satin cloths, for instance, have a "sheen" or a power of regular reflection of light which causes work with such materials to be very trying unless the worker is so placed with reference to the source of light that none of the rays can be directly reflected from the material into his eyes.

"Frequency of Occurrence" Curves.

It is convenient to employ a graphic method of setting forth the results of observations of illumination in factories to show what are the most general illuminations at present prevailing in any class of factories or processes. Curves may be drawn to represent the frequency of occurrence of different values of illumination. Such curves have the advantage of being in some degree an indication of the actual conditions which experience has shown to be necessary. In the case of foundries, for instance, there will be some rooms where the illumination attained is very high, and others where it is exceptionally low; but the question then arises, How do they tend to group themselves between the extremes?

To investigate this, we arrange the observations in groups—each group containing all those falling within certain selected limits. Then by taking a horizontal scale to represent illumination, and a vertical one to represent the number of observations in each group, we can plot on the diagram a number of points which in most cases lie on a fairly smooth curve. The area of a portion of this curve bounded by two vertical lines or ordinates drawn to correspond with any two illuminations, will represent the number of observations of illumination lying between these two limiting values; and the curve thus indicates the manner in which the illuminations observed are distributed among the places examined. One ordinate can be drawn to divide the curve into two equal areas, and the observation points into two corresponding groups. The number of observation points in each group is the same. In the one group of factories each observation point has an illumination less than that corresponding to this ordinate; in the other, greater. The point from which this ordinate is drawn is denoted the mid-point of the curve, and it is to this mid-point we wish to draw attention. The general shape of the curve should also be noticed. If a curve slopes gradually from its maximum ordinate towards the right, the number of factories having a higher illumination than that most commonly found is considerable; but if on the other hand it falls sharply away, the illumination found in the larger number of factories is seldom exceeded. [Further details are given in Appendix XV.]

Daylight Factor.

If it were possible to remove the walls and roof of a building, and so allow the full amount of light from an unobstructed sky to reach a given point, the illumination there would have a very much enhanced value. The ratio of the actual value of the illumination to this enhanced value, expressed as a percentage, is termed the "daylight factor," and is a measure of the lighting efficiency of the building at the point under consideration. Compared with the variations of the outside illumination, the daylight factor may be regarded as roughly constant for any point in a factory, and mainly depends on the window area which is effective in admitting light to the point in question. [The term is fully discussed in Appendix XV.]

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**Increase in Gas-Cookers in Germany.**—A statement published under the authority of the Central Gas Publicity Bureau of Berlin, in the "Journal für Gasbeleuchtung" of the 11th inst., says that the war has afforded an opportunity of gaining information as to the increase in the use of gas for domestic cooking purposes. It was necessary for an estimate to be given to the authorities as to the metal requirements of the makers of gas-cookers for domestic use (apart from large gas-cookers for institutions, &c.), in order that the necessary supplies of metal might be allotted. An estimate was given of the number of burner-taps required, based on the number used in the manufacture of gas-cookers in the last year before the outbreak of war. It put the figure at 1½ millions. It has been further estimated that, on an average, 2·2 taps are used on each cooker. These figures show that there were produced in Germany in the last year of peace 680,000 gas cookers and ranges.

# AMERICAN ILLUMINATING ENGINEERING SOCIETY.

### Programme for the Washington Convention.

The Ninth Annual Convention of the American Illuminating Engineering Society was held from Monday to Thursday of last week at Washington. According to the current month's "Transactions" of the Society, the papers and reports to be presented were "replete with new and valuable information on practically every phase of lighting." Many of the papers covered, it was stated, extensive special investigations conducted by authorities of high standing; while for commercial men, or those interested chiefly in selling more and better lighting services, there were a number of especially interesting communications. A brief indication of the series—39 in all—is given; and pending an opportunity of reproducing some of the more important, the following abstracts may be of interest.

Report of the Committee on Nomenclature and Standards.—An annual report containing particulars of new terminology, definitions, symbols, &c.

Report of the Committee on Lighting Legislation.—A comprehensive statement of the status of lighting legislation. Includes a code on lighting which was drafted by the Committee.

Report of the Committee on Research.—Includes the results of an extended investigation of the various methods of heterochromatic photometry.

Report of the Committee on Progress.—This reviews the features of lighting progress during the past year. For the most part the report, which is rather a long one, is a summary of published matter; but it also contains much valuable information not heretofore on general record.

Lighting of Ships; by H. A. Hornor.—The requirements of ship and marine lighting are set forth, and methods of wiring and details of fixtures are discussed.

Lighting of a Passenger Steamer; by H. F. Spaulding.—Sketches past and present practise in marine lighting. The lighting requirements of a passenger boat are discussed, and compared with similar installations ashore. Describes the lighting system on the s.s. "Noronic"—a lake passenger boat. Includes illumination test data.

Life Testing of Incandescent Lamps at the Bureau of Standards; by G. W. Middlekauff, J. F. Skogland, and B. Mulligan.—Outlines the methods of tests and inspections followed by the United States Bureau of Standards. Includes a description of laboratory equipment.

Use of Portable Photometers; by W. F. Little.—Outlines the desirable procedure in the conduct of photometric tests with portable apparatus. Discusses the planning of a survey, and precautions which should be taken; a method of testing candle-power, illumination intensity, and brightness; maintenance of photometric apparatus; photometric errors, and means of avoiding them.

Compensating Illuminating Test Plates; by C. H. Sharp.—A discussion of the various errors inherent in illumination test-plates in use, and a description of a new form of construction which has been devised to eliminate these errors.

Illumination Efficiencies as Determined in an Experimental Room; by Ward Harrison and Earl A. Anderson.—A report on a series of illumination tests performed in a portable room designed for the purpose. The room dimensions and the arrangement of the outlets were varied to approximate the diverse conditions encountered in practice. Wall, ceiling, and floor combinations of white, black, and intermediate colours were tested with units of three general types of light distribution.

Semi-Direct Office Lighting of the Chicago Edison Building; by W. A. Durgin and J. B. Jackson.—Gives a description of a typical office and comparative tests of five lighting systems, showing the relative eye fatigue, glare, shadows, &c. Data are given on the illuminating effectiveness, appearance, dust factor, &c., for the complete installation.

Street Lighting with Gas-Lamps; by Geo. S. Barrows.—A discussion of modern street lighting with gas.

Arc Lamps for Street Illumination; by H. E. Clifford.—Outlines recent developments and characteristics of arc lamps designed for street illumination.

New Types of Incandescent Lamps and their Relation to Street Lighting Problems; by W. H. Rolinson.—A brief historical review and consideration of the fundamental requisites of street lighting. Various systems are classified according to unit and location. The choice of illuminants, means of regulation, and general equipment are also discussed. Special attention is given to recent developments in electric incandescent lamps for street lighting.

Application of Principles of Scientific Street Lighting; by F. A. Vaughan.—A comprehensive statement of the requirements of street lighting, based upon a special investigation conducted in Milwaukee, Wis.

How can a Combination Gas and Electric Company Render the Best Service to the Customer? by A. B. Spaulding and H. N. Potter.—Deals with the question of proper service to the customer; the education of salesmen and the customer; the relation between the salesman and the customer; and the question as to whether the sale of gas and electric illumination should be handled on a competitive basis or by combination men.

The Selection of a Standard Unit for Lighting; by W. H.

Moulton.—Discusses the problem of selecting a new style of standard fixture for commercial work. Features of various lighting units are outlined.

Small Incandescent Lamps and Special Illumination Problems; by R. P. Burrows.—Deals with improvements in the manufacture of small incandescent lamps for novelties and the industrial and medical fields. A number of present applications of these lamps are mentioned.

Illumination and One Year's Accidents; by R. E. Simpson.—Gives results of a study of one year's industrial accident records, the purpose of which was to determine the effect of the lighting conditions on the causation of accidents. Typical accidents are mentioned to show how lighting conditions have been responsible for injuries to workmen.

Application of Crova's Method of Coloured Light Photometry to Modern Incandescent Illuminants; by H. E. Ives and R. F. Kingsbury.—Discussion of the advantages and requirements of Crova's method for overcoming colour differences in heterochromatic photometry.

Relative Photographic and Visual Efficiencies of Light Sources; by L. A. Jones, M. B. Hodgsen and Kenneth Russ.—Sets forth the relation between the visual and photographic efficiencies of various lighting sources. Methods for the determination of these relations are outlined. A large amount of data is included, to show the relations between several sources and three types of photographic plates.

Method for Studying the Behaviour of the Eye under Different Conditions of Illumination; by F. K. Richtmyer and H. L. Howes.—Describes a method of studying visual efficiency which gives indications of being well-adapted to quantitative measurements of the manner in which different conditions of illumination affect the working eye. Several curves are included to show the resemblances and differences in the rates of reading various matter by several observers. Other curves exhibit the effects produced by placing frosted and unfrosted lamps in the field of vision.

Flame Pilot Ignition of Indandescent Gas-Lamps; by C. W. Jordan.—The features, advantages, and application of various methods and systems of pilot ignition are discussed.

Practical Illumination as Exemplified by Some Recent Installations of Incandescent Gas-Lamps; by R. F. Pierce.—A report on the various recent installations of gas-lamps.

Mercury-Vapour Lamps for Industrial Lighting; by W. A. D. Evans.—Outlines the lighting requirements of various industries; special reference being made to the application of the mercury-vapour lamp.

Retinal Sensibilities Related to Illuminating Engineering; by P. G. Nutting.—Points out the retinal sensibilities of importance in illuminating engineering, such as sensibility to brightness and brightness differences and to colour and colour differences. The interrelations of these sensibilities are duly outlined and methods given for their quantitative determination. The best data on each sensibility, including much that is new, are summarized in each case.

Vision and Brightness of Surroundings; by P. W. Cobb.—Outlines the results of an investigation of visual acuity and difference threshold. Describes new apparatus and methods used.

Flux Method of Obtaining Average Illumination.—Describes a method of obtaining the average illumination from a lighting installation on the basis of the total flux generated by the light sources. The lower hemisphere surrounding the lighting unit is divided in three 30° zones; and the lighting unit is classified according to the percentage of flux delivered in these zones. Having determined the proper classification for any lighting unit by means of one or more of the graphic charts shown, one is enabled to calculate the flux incident on the floor-area for each unit, and (by adding them all together) determine the flux over the entire floor-space.

Artificial Illumination of Architectural Interiors; by David Crownfield.—Deals with the lighting requirements of large interiors of different architectural styles and classes.

Artificial Lighting of Typical Offices in the State, War, and Navy Department Building; by W. E. Chapman.—Gives a brief description of the lighting conditions in a typical office of this building, which was erected in 1886. The present lighting requirements, and a description of the latest remodelled installation employing tungsten lamps are given.

Lighting in Downtown Office Buildings; by A. O. Dicker and J. J. Kirk.—Contains a description of typical downtown office buildings in the City of Chicago, representative of periods thirty, twenty, fourteen, and six years ago. The lighting in these buildings is contrasted with an installation in a recently completed building in the same district.

Present Practice in the Lighting of Armouries and Gymnasiums with Tungsten Filament Lamps; by A. L. Powell and A. B. Oday.—Gives descriptions and tabular data on the lighting requirements of numerous armouries and gymnasiums.

Ultra-Violet Light and the Eye; by W. R. Burge.—An investigation to determine which wave-lengths in the ultra-violet region of the spectrum are harmful to living tissue, and the mode of action of these wave-lengths in producing injury.

Production and Application of Ultra-Violet Rays; by M. von Recklinghausen.—A brief description of the different sources of ultra-violet rays. Includes a short description of the salient features of the system of sterilization of water by ultra-violet rays, and several pictures of recent plants.

The Parabolic Mirror; by F. A. Benford.—Directs attention to the increasing importance of parabolic reflectors for the projection of light for military and naval service, transportation, flood lighting, and spectacular illumination. For the most part a mathematical treatment of the reflector used with point, spherical, and disc sources. Probably the most complete treatment of the theory of the reflector that has thus far been presented.

Some Experiments on the Eye with Inverted Reflectors of Different Densities; by C. E. Ferree and G. Rand.—The fourth of a series of papers in which the effect of the various conditions of lighting on the eye is investigated. Gradation of surface brightness is made the chief variable. Semi-direct reflectors of six degrees of density are employed; and a correlation is made between the illuminating effects obtained and the tendency to cause loss of visual efficiency and produce ocular discomfort.

Effect of Variation of Atmospheric Pressure on the Candle-Power of Flames; by E. B. Rosa, E. C. Crittenden, and A. H. Taylor.—A summary of an investigation conducted at the United States Bureau of Standards.

Yellow Light; by M. Luckiesh.—Knowns and unknowns, and the various opinions regarding yellow light, are briefly discussed with respect to visual acuity, glare, fatigue, penetrating power, and æsthetic value. Outlines the procedure involved in altering the light from tungsten lamps to match a light from the kerosene flame or the old carbon incandescent lamp.

Artificial Illuminants for Use in Practical Photography; by C. E. K. Mees.—Illuminants differ in efficiency, quality, size of source, consistency, and flicker. Tables are given showing a classification of illuminants according to these characteristics when they are to be used with each of three classes of sensitive photographic materials—those sensitized to the whole spectrum, those with their sensitiveness in the blue-violet, and those sensitive only to the ultra-violet. Another table shows a classification of various available artificial light sources according to the photographic operations for which they are suitable.

## EYE-EFFICIENCY UNDER DIFFERENT CONDITIONS OF LIGHTING.

### Effect of Varying the Distribution Factors and Intensity.

Two lengthy papers on the above subject were presented at one of last year's meetings of the American Illuminating Engineering Society; and the full texts of them appear in the August part of the "Transactions"—extending to nearly a hundred closely printed pages. The authors of the communications were Mr. C. E. Ferree and Miss Gertrude Rand, of Bryn Mawr College, who had jointly prepared previous papers on the same subject.

The synopsis of the first of the present two papers points out that in their previous paper [read in 1913] a plan of work was outlined by one of the writers for the study of the effect of different kinds of lighting conditions on the eye. The problem was divided into three parts: (1) The determination of the conditions that give in general the highest level or scale of visual efficiency; (2) the conditions that give the least loss of efficiency for continued work; (3) the determination of the conditions that cause the least discomfort. Tests were described, especially designed to meet the requirements of each division of the work, and results were given to show generally the sensitiveness of the tests employed.

The work of the present paper is confined to the second division of the problem, and should be considered as an "explorative investigation for the determination of factors." Six aspects of lighting are considered provisionally, as sustaining an important relation to the eye—the evenness of the illumination, the diffuseness of the light, the angle at which the light falls on the object viewed, the evenness of surface brightness, intensity, and quality. Only the first five are dealt with in the paper. The first four are called, for convenience of reference, distribution factors.

In order to produce the variation in the distribution factors needed for the purposes of the test, three types of reflectors in common use were employed—a direct, a semi-indirect, and an indirect. The reflectors were selected with reference to the object of the investigation rather than as representative in every case of any particular principle of lighting. The illumination effects produced in each case were specified in the following ways: (1) A determination was made of the average illumination of the room under each of the three installations. (2) The brightness of prominent objects in the room—such as the test card, the reflectors for the semi-indirect installation, the reading page, specular reflection from surfaces, &c.—was given. (3) Photographs were made of the room from three positions under each kind of installation. These effects were then correlated with the results obtained with the eye-test.

In order to determine the effect of varying intensity with a certain grouping of distribution factors, lamps of different powers were used with each type of reflector employed in the distribution series. The illumination effects produced were specified by illumination and brightness measurements in the way described above, and the effects were again correlated with the results of the eye-tests conducted at each intensity of illumination.

The second of the 1914 papers was a continuation of the papers presented by the same authors to the Society in 1912 and 1913. It described the completion of the plan of work outlined in the

preceding papers for one set of lighting conditions for three of the tests thus far devised by one of the writers [Ferree]—namely, a test of the ability of the eye to hold its efficiency for a period of work; a test for loss of efficiency of the fixation muscles; and a test for the comparative tendency of different conditions of lighting to produce discomfort. A report was also given of some miscellaneous experiments related to the hygienic employment of the eye, in which the following points are taken up: The effect of varying the area, and conversely the intrinsic brightness, of the ceiling spots above the reflectors of an indirect system of lighting; the effect of varying the angle at which the light falls on the work in a given lighting situation; the effect of using an opaque eye-shade with dark and light linings with each of the installations of artificial lighting employed in this and the previous work; the effect on the efficiency of the fixation muscles of three hours of work under these installations; the effect of motion pictures on the eye for different distances of the observer from the projection screen; a determination of the tendency of different conditions of lighting to produce discomfort; and a comparison of the tendency of these conditions to produce discomfort and to cause loss of efficiency.

# CORRESPONDENCE.

*[We are not responsible for opinions expressed by Correspondents.]*

## Mr. Newbigging—Revolutionist.

SIR,—You have been very outspoken in your criticism of certain remarks I made in a paper read before the British Association, in Manchester, on the 9th inst.

I do not complain of this, but rather welcome it. My remarks were intended to rouse the gas industry from its lethargy. Instead of saying: "There is no reason why the Gas Department should not eventually become the gaseous fuel supplier," it would have been more correct to say "*will* become the gaseous fuel supplier." The gas industry in years to come must take this position, or practically no position at all. This is patent to anyone who does not shut his eyes to facts, and the trend of events.

It is obvious that the change will be gradual, and many years elapse before the position of the lighting load, and that of the cooking, heating, and industrial load, are reversed from what they are to-day. The best means to be adopted to meet the change will, as you say, have to be the subject of critical investigation.

In my opinion, one of these (to effect economies) must be a considerable reduction in the calorific value of the gas. This would not be so revolutionary as you foreshadow. Modern methods of carbonizing are teaching us that, from a ton of coal, very large yields of gas can be obtained of comparatively low calorific value, without unduly altering its specific gravity or excessive saturation with incombustibles.

You put a strong case as to the advantages of gas for lighting. But at the same time you cannot ignore those on the side of electricity; and, unfortunately, they are the ones that weigh with the public. There are many people using gas for domestic lighting who are not doing so because they prefer it, but because of the cost of fitting-up their houses for the change to electricity. The existence of a greater part of our lighting load depends on this adventitious circumstance, and is therefore a precarious one.

The sooner we take into consideration the position which is being created by the lighting consumption becoming a gradually diminishing proportion of the total consumption, the better. We are not holding our own for lighting; whereas for heating, cooking, and industrial purposes the development is considerable, and the field larger. The gas industry can occupy and establish itself in this field if its product and selling price are gradually adapted to the altering conditions.

You are misleading in the interpretation you put on some of my statements. For example, you say: "Mr. Newbigging's amiable intention appears to be to completely hand over the consumers of gas for lighting purposes to electricity whether they would or no." This is not correct, because I say: "Gas still required by those who preferred it for lighting, and for street lighting, would be taken from the high-pressure mains, or even the existing mains at a higher pressure than is now maintained."

I am quite content to remain in "a position of splendid isolation in this particular matter," leaving the future to prove or disprove the correctness of the views I have expressed.

J. G. NEWBIGGING.

*Manchester, Sept.* 24, 1915.

[There is agreement with Mr. Newbigging in his modification of the statement that the Gas Department "will" become the gaseous fuel supplier. There is no article of our faith in relation to the gas industry that is stronger than the one that holds that it is the destiny of the industry to become the supplier of gaseous fuel; but we hope, too, that coincidently it will remain a supplier of gas for other purposes. There is some relief in knowing that Mr. Newbigging is of opinion that "many years" will elapse before the position of the lighting load, and that of the cooking, heating, and industrial load, are reversed from what they are to-day. Our correspondent does not dispute the advantages of gas from the qualitative, efficiency, and economy points of view; but yet he submits that it is only the cost of fitting-up houses that keeps many people from changing-over to electricity. This is a very thin thread indeed between the retention and the loss of custom. Why would they pass over to electricity if it were not for the cost of fitting-up? Is it to gain convenience, and to lose quality? If so, it points to the education of such householders being seriously at fault regarding the advantages of the quality of light. That is the direction in which the gas industry should be up and doing in connection with lighting. Naturally, we must expect the lighting business to become a gradually diminishing proportion of the total consumption, in view of the extension of consumption for heating, cooking, and industrial purposes. No one can have seen the gas industry duplicate its volume of business since electricity has been a public supply, with 40 to 50 per cent. of the total business representing day consumption, without appreciating this fact. However, the statement in the third paragraph of Mr. Newbigging's letter indicates that, in his opinion, the "future" (referred to in the last paragraph) is far distant before the correctness of the views that he has expressed will be either proved or disproved.—ED. J.G.L.]

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SIR,—It is very satisfactory to learn that there is another "revolutionist," besides myself, in the profession, because this is what you styled the writer on the occasion of the delivery of his lecture on low-temperature carbonization at the Manchester University in 1913.

What I pointed out then I maintain now, that it is little short of criminal to waste valuable coal by the absolute destruction of some of its most valuable constituents—light oils, heavy oils, and ammonia. But this is what is being done by all processes of high-temperature distillation.

Yes; I know the argument that gas companies' prime object is to obtain the utmost yield of gas per ton of coal. But cannot this effort be purchased too dearly?

At the time, I ventured the remark that electricity was overtaking gas by leaps and bounds, and it was open to the gas companies to meet the competitor in the gateway, before it was too late.

What I endeavoured to point out was that the ultimate function of a gas-works would be to provide the power required by the electricity undertakings, leaving to the latter the distribution and illumination; and to this I believe that it will eventually come. The power required would naturally be by means of power gas as evolved by an ordinary "producer." But I ventured to indicate that, by using raw bituminous fuel in producers, many of the good things which high-temperature carbonization now destroys would likewise be destroyed in a high-temperature "producer." So the idea was propounded that the raw coal should first be carbonized by a "low-temperature" process, whereby the oils and light hydrocarbons of great value would be saved. Some 5000 cubic feet of heating gas, of about 300 B.Th.U., would be obtained, and ultimately a beautiful easily-burning coke, practically all carbon. This when consumed in a "producer" would yield a very large quantity of power gas—infinitely cheaper than steam power; while practically all the ammonia possibly obtainable would be recovered in the form of sulphate. Figures, diagrams, and analyses, on a trustworthy basis, were given to substantiate the writer's views.

Over and over again, scientific societies have pointed out the absolute necessity—now and after the war—of conserving our coal supply and its valuable constituents. That this can only be done by thoughtful attention to the best means of saving the constituents, and upsetting the present fundamentally ruthless methods of destroying them by high-temperature processes.

I maintain that if our industry is based on methods opposed to all scientific and economical laws, such an industry must be modified and revised to fall in line with what may be termed "Conservation *v.* Destruction."

Sporadic ideas and views are of little value. The subject must be tackled by organized scientific investigation; and this seems very difficult of attainment.

F. D. MARSHALL.

*Queen Anne's Chambers, Westminster, Sept.* 22, 1915.

[We agree whole-heartedly with the last sixteen words of Mr. Marshall's letter.—ED. J.G.L.]

## Radiant Heat Distribution.

SIR,—It is quite evident from your reply to my last letter that the discussion will develop into a game of "Hide and Seek" if I permit you to draw me away from your actual statements.

I criticized your assumption that radiation as radiated from a gas-fire can be "concentrated." Whether it is you or I that "play upon words and assumptions" or is "blind to contexts," may be left to the judgment of your readers, after re-rendering the sentence you used (and not your misquotation) as follows: "The real question is which is the best distribution for practical purposes, the more concentrated or the more distributed *radiant* heat." When quoting last week, you left out the word which I have italicized, and which is the whole gist of contention. Had you left it out of the sentence when first used, much ink would have been saved. The whole expression "distribution of radiant heat," which you used on p. 438 when introducing this matter, is a misnomer. Radiant heat *radiates*, which is quite different from *concentration*, the lexicon meaning of which you give, but it in no way helps you in your definition of its use. Radiant heat does not require "distribution;" it distributes itself.

As a large manufacturer of coal-grates, I am in a position to state that for at least the last ten years, the majority of fireplaces sold (including registers, mantel registers, and interiors) have been recessed. My sketch accurately illustrated an ordinary fireplace interior, and not one specially made for the gas-fire, as was the case in the sketch to which you refer.

As you lay emphasis upon a long test for justifying your views on air

movement, perhaps you will be good enough to give full details of this, so that others may see how firm is the foundation of your confidence.

JAS. W. WILSON,
[Wilsons and Mathiesons, Limited.]

*Leeds, Sept.* 24, 1915.

[We fail completely to find, in anything written by way of comment on Mr. Wilson's communications, any endeavour to draw him away from our "actual" statements. It is not generous on his part to continue to ignore the *precise* words employed by us, and to insist on trying to lead readers to suppose that we had spoken of "concentrated" radiant heat when the terms "*more* concentrated" and "*more* distributed" were used comparatively. The word "radiant" before "heat" was not purposely omitted from our comment last week; and seeing that the whole controversy is, and has been from the beginning, on the subject of radiant heat, no reader will have been misled by the inadvertent exclusion of the word from the sentence in question. Mr. Wilson knows full well—at least, we give him credit for doing so, in view of the quotations made last week from his own letters—just as other readers do, what we meant by "*more* concentrated," and "*more* distributed." He tells us he is prepared to leave the matter to the judgment of our readers; we shall be quite content with that judgment. Mr. Wilson's "ordinary" fire-place interior is not the interior that *exists* to-day in millions of rooms. Those that *exist* are the "ordinary" fire-places; the more modern ones that are very gradually being adopted in new and altered houses are not the "ordinary" ones that have prevalence. With reference to air movements which, in Mr. Wilson's mind, will have such unhappy effect upon semi-circular fronted fires, surely, he, as a gas-fire maker, must know the form of tests that a firm of gas-fire makers, with a laboratory and competent technical staff, would employ in putting to trial the point in question. However, he requires "full details" of the tests. Perhaps he will apply to the Richmond Gas Stove and Meter Company, who made them.—ED. J.G.L.]

# REGISTER OF PATENTS.

## Cerium-Iron Lighters for Lamps.

EHRICH AND GRAETZ, of Berlin.

No. 13,527; June 3, 1914. Convention date, April 20, 1914.

This cerium-iron lighter for lamps is said to be completely protected from atmospheric influences, and therefore eminently suitable for use in outside lamps where, without it, it has been found that such lighters, for various reasons, soon lose their efficacy.

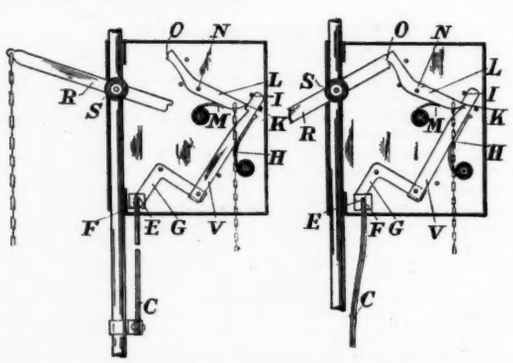
The main feature of the invention consists in the lighter being enclosed on all sides in a completely weather-proof manner, and coming into contact with the atmosphere only at the time the lamp is being ignited. A most important point is said to be that the lighter is completely enclosed during the time the lamps are not burning—"the danger of its being damaged when the lamp is burning, when the lighter is secured near the lamp, being less great on account of the heat of the lamp."

## Automatic Closing of Gas-Cocks.

BÖHRER, K., and SCHELL, E., of Hopfingen.

No. 14,143; June 11, 1914.

This apparatus is for effecting the automatic closure of individual gas-taps when the gas supply is shut off at the main cock, and so preventing escapes of gas occurring.




**Bohrer and Schell's Automatic Gas-Tap Closer.**

The illustration shows the invention applied to a gas-pipe when in the closed position, and during the time of ignition.

Clamped to the gas-pipe is a composite strip C, formed of hard and soft metal, which strip engages at its free end E in a cavity F of an angle lever G. A bar V, pivoted to the lever, is controlled by a spring H and a pin I, and possesses a projection K, in which engages a locking-piece L, held constantly in its proper position by a spring M and supported on the pivot. At its other end is a projection O, which engages with a lever R, the pivot of which actuates the gas-cock, and is surrounded on the outside with a spiral spring S. The entire mechanism is located in a casing fixed upon the gas-pipe.

For the purpose of opening the cock, the lever R is drawn downward, and then engages fast in the projection O, so that the gas can be ignited. By means of the uprising heat the strip C moves in the radial direction towards one side, and carries with it the angle lever G, which, in turn, moves the bar V upwards, so that the locking-piece L engages the projection K. In this position, the mechanism remains until the moment of the cooling of the heated strip—that is to say, until the gas is shut off at the main cock. At this moment the strip moves back again and moves with it the lever G and the bar V, so that the locking-piece L releases the cock lever R, which moves back into its original position and closes the pipe. There is attached to L a chain, which releases the cock lever by drawing down the locking piece, so that the cock can be closed also in the ordinary manner.

## Furnaces for Distilling Carbonaceous Substances.

CRAWFORD, W. W., of Westminster.

No. 18,437; Aug. 8, 1914.

This furnace for the destructive distillation of bituminous coal shales and the like is of the type in which a plurality of retorts are disposed about a common axis, and arranged to rotate. Rotary coal distilling devices of this type are known, the patentee points out; but rotation in such cases has been for the specific purpose of bringing successive retorts under the more concentrated influence of a heating device disposed at a stationary point outside the rotary part. The present invention consists of a series of retorts and inter-retort heating chambers; the retorts and chambers, together with the heating means therefor, being revoluble and radially disposed about a common axis—rotation being necessary for the purpose of automatically charging and discharging the contents of the retorts, and allowing, by a variation or a setting of the speed, to apportion the time for coking as may be desired.

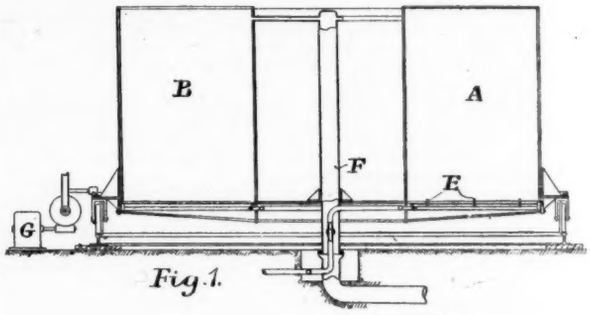



*Fig. 1.*

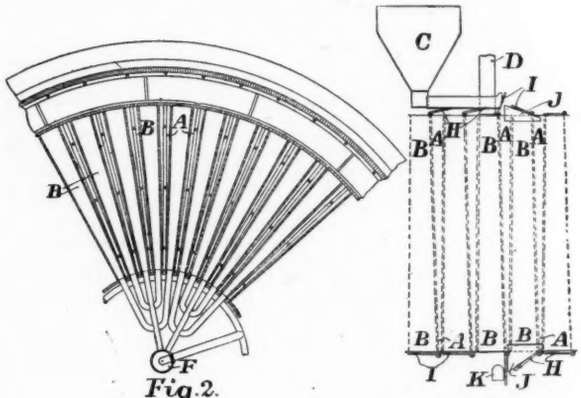



*Fig. 2.*

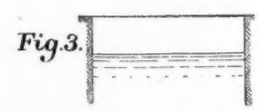


*Fig. 3.*

**Crawford's Rotating Retort.**

Fig. 1 is a part sectional side elevation. Fig. 2 is a part sectional fragment of fig. 1 in plan. Fig. 3 shows the detail of the charging and discharging gear in part side elevation (detail not material to the above functions being omitted for the sake of clearness).

The operation of the invention is as follows: The furnace as a whole is filled with the carbonaceous material to be distilled—an operation preferably effected by employing the hopper C and cutting out the action of the plunger D. Gas is now turned on and the burners E lit within the furnace chambers—the hot gases of combustion passing upwards and heating the walls of the retort chambers B. The gases may either be allowed to escape into the atmosphere or, if desired, may be collected at the top of the chambers A. In some cases it may be desirable to mix the gases with the products of distillation, in which case connection may be made between the chambers A and the duct F. The motor G is started after a sufficient time has elapsed, and the furnace as a whole rotates. Distillation takes place in the chambers B by means of the heat transmitted through the walls; and gases as

distilled pass through pipes into the central duct F, whence they are drawn off, the process continuing until the whole of the constituents recoverable at the temperature produced by the burners are obtained. "With this type of furnace the carbonaceous contents can be distilled at a very low temperature; the effect being to produce a minimum of gas and a maximum of oil and tarry matters."

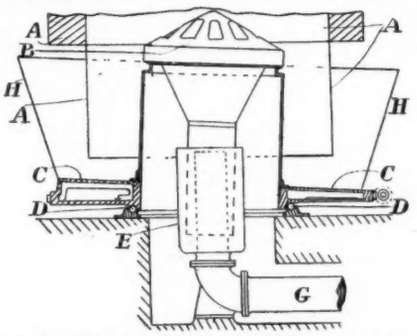
As the furnace rotates the retort doors H at the top and bottom open, owing to the projection I engaging with the plates J K, and the plunger D is actuated to discharge the contents. Immediately the projection I has passed the lower plate K, the lower door closes while the upper one remains open—allowing a charge to enter the retort. Directly the upper door H has passed the hopper mouth, it closes; and distillation proceeds until, in the course of the revolution of the furnace, the retort returns to the discharge station and the operation is repeated. The outward flaring of the retort chambers B materially assists the discharge; a comparatively small amount of power imparted to the plunger being sufficient to drive out the contents.

The desired end is to obtain a distillate over a comparatively low temperature—say, 300° to 600° C.—but by increasing the size of the chambers A and the numbers of the burners E, distillation may take place at any desired temperature. Also, by increasing the size of the plant, charging and discharging may take place a plurality of times per furnace revolution; but whether a single or multiple discharge per revolution be employed the speed of rotation controls to a great extent the temperature of distillation, and "speed therefore is a very convenient assistant or auxiliary control to the working of the furnace."

## Grates of Gas-Generators.

R. & J. Dempster, Limited, and Beard, G. F. H., of Manchester.
No. 9413; June 28, 1915.

This invention—relating to the grates of gas-generators used for the manufacture of water gas—has for object to provide "a simple and effective combination of grate and trough . . . whereby desirable movement may be imparted to the material in their neighbourhood."




**Beard's (R. & J. Dempster) Gas-Generator Grate.**

The illustration (a sectional view of one form of upright grate and adjacent parts of the producer) shows an ash receptacle or water-trough mounted about the grate. A is the lower portion of a producer; and B the upper part of the grate, the outer walls of which are in connection with an inclined plane C, so that the axis of the grate is perpendicular to the plane or is not perpendicular to a horizontal plane. The inclined plane forms the upper surface of a base which is capable of rotation about a horizontal plane by being mounted on ball-bearings D, and by being provided with a worm wheel (all round the circle forming the periphery of the base) which is in gear with, and capable of operation by, a worm.

The inner part of the grate is partly within an open socket piece E, for containing water to form a seal, in connection with the pipe G—enough clearance being provided within the socket piece to allow free movement, without interference with the internal connection between the pipe and grate. An extension of the pipe terminates at a level above that of the water (not indicated) in the piece E. A water-trough or ash or like receptacle H is indicated, the axis of which is not perpendicular to a horizontal plane, attached to the surface C of the base, so that one part of the base of the trough is lower than another.

The movement of the grate, due to its mounting upon the rotary base, will, during rotation, have a disturbing effect upon the material about the grate, which will facilitate the fall of the material at different points as the base revolves. Added to this the ash in the trough will tend to accumulate at the lower portion of the bottom, with the result that it will pass underneath the depending wall (within the trough) of the producer, and eventually cause other ash or material above it on the outside of the wall to pass over the upper edge of the trough, "without the necessity for the use of barriers or the like commonly used for this purpose."

## Condensing the Volatile Gases Distilled from Carbonaceous Material [Peat].

Prioleau, J. R. H., & W. L. St. J., of Chelsea, S.W.
No. 23,165; Nov. 27, 1914.

This invention—of especial application to the distillation and coking of peat—relates to a method of carrying and condensing the volatile gases distilled from carbonaceous materials in a retort, with the object of obtaining the several gases quickly at the lowest temperature consistent with the evolution of the volatile matters without injury, and to obtain gases given off at different temperatures at the same time.

It has previously been proposed, the patentees mention, to traverse the materials through a closed retort and to draw off the volatile gases at several points in its length, either into a common flue or separately; the gases being thereafter carried away for further treatment in various ways—for instance, to render them suitable for heating the retort. In certain cases also heated air blown through an injector has been used for the removal of the gases without condensation; and the gases have thereafter been passed through condensers for the extraction of some of the distillates present.

The invention is of this class, and the patentees propose to employ means for continuously traversing the carbonaceous materials through a hermetically closed single chamber retort, subject to surface heating only, but having an ejector condenser, or a series of ejector condensers, directly and closely, but separately, connected to the interior of the retort, and operating by means of a non-condensible, or substantially non-condensible, gas at a low temperature, so as to cause suction on the gas producing retort at a given point, and immediate condensation of the gaseous matters thus drawn into the condenser, by reason of the low temperature of the non-condensible gas.

By connecting the series of separate ejector condensers to the gas producing retort at successive points in its length, or by connecting thereto (either continuously or at intervals) a separate condenser pipe, or chamber, substantially parallel to the retort, different volatile matters distilled at the several successive points, corresponding with the temperature ruling at these points, may be withdrawn from the retort simultaneously and their condensible portions immediately recovered.

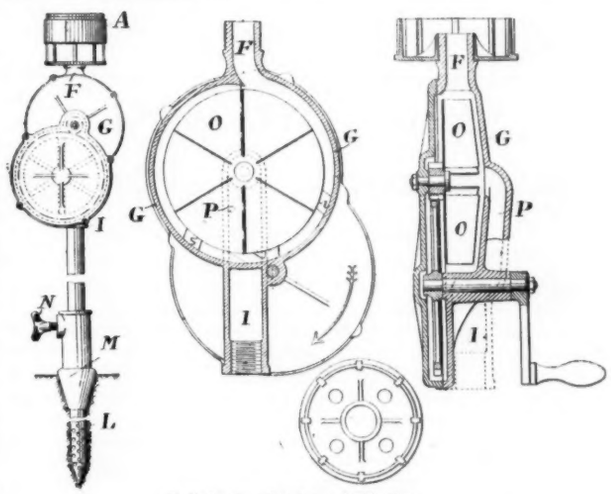
Further, the drawing off of the gases is carried out without them having to pass through other zones of the retort, either hotter or colder—"a point of material advantage, as such passage would subject them to 'cracking' or decomposition conditions which might alter them chemically"—thus the resultant oils would be different.

Preferably a horizontal retort having a conveyor screw is employed, and preferably also non-condensible gas evolved from the carbonaceous material will be used for the condensing element in the condensers—the same gas being used over again after passing it through purifying and cooling apparatus, by means of a pump or other suitable mechanism.

## Indicating and Locating Gas Leakages.

Tully, C. B., of Queen Victoria Street, E.C.
No. 2781; Feb. 20, 1915.

This invention is said to relate to "that class of means whereby an elastic fluid is pumped through a pipe system into the presence of a device adapted to determine its composition or to detect contamination; and it has for its object to provide a simple and efficient portable instrument for indicating and locating gas leakages from mains." This is effected by combining with a suitable form of instrument adapted to give an indication of the presence of gas, a hand pump (provided with a suction pipe for its support) that can be inserted into the ground in the neighbourhood of the portion of the gas-main to be tested—the delivery mouth or pipe of the pump discharging to the receiving portion of the indicating instrument.




**Tully's Gas-Leakage Indicator.**

One way of carrying the invention into effect is illustrated by an elevation of the appliance viewed from the rear; also a part sectional front elevation of the pump (to a larger scale), and a vertical transverse section.

A represents an instrument depending for its action on a diffusion of the gas through a permeable septum (such as unglazed terra cotta) into an enclosed chamber, causing the movement of an index over a dial. This instrument is carried by an adapter having a plate bottom with milled edge, and a central screw threaded boss capable of being fitted to the delivery branch F of the pump. The plate has perforations in it, so that the gas withdrawn from the ground and delivered by the pump can—after impinging upon the porous septum—escape. The suction branch I of the pump is in alignment with the delivery branch F, and is removably secured to a length of tube which is pointed and formed with perforations L. The tube may be provided with a tapered collar or tubular plug M, whereby a sufficiently tight joint can be made between the tube and the mouth of the hole in the ground in which it is inserted. A set-screw N will permit the position of the plug being altered if desired.

The pump comprises an exhausting fan O, to the eye of which fluid from the suction branch is conducted by a passage P. The fan (driven by gearing from a handle) has a series of (say) six thin metal vanes radially arranged and fitting the surrounding casing loosely, so that when the pump is operated a steady, gentle stream of fluid will be supplied to the gas detecting instrument.

# PARLIAMENTARY INTELLIGENCE.

## HOUSE OF LORDS.

The Clackmannan County Water and Glasgow Water Order Confirmation Bills were last Wednesday brought from the Commons, read the first time, and—pursuant to the Private Legislation Procedure (Scotland) Act, 1899—deemed to have been read a second time and reported from the Committee.

## HOUSE OF COMMONS.

The Clackmannan County Water and Glasgow Water Order Confirmation Bills were last Wednesday read the third time and passed.

### London Lighting.

Answering questions put last Thursday by Sir C. Kinloch-Cooke in regard to this matter, Sir John Simon said: The regulation of lighting in the Metropolitan area, with a view to minimizing risk from air raids, has been most carefully studied by the expert officers of the Admiralty, and the scheme adopted by the Home Office and the police authorities is based on their advice, and is the result of repeated observations alike from the air and from the ground. The main object to be aimed at is uniformity rather than absolute darkness; and it is a matter of great importance that the scheme should be applied equally in all parts of the area—exceptional darkness being as likely to prove a distinctive mark as exceptional brightness. Private citizens and local authorities have shown themselves generally willing to accept the application of the scheme, and the lighting orders made to give effect to it; but as some cases of local departure from the scheme have come to my notice, I am proposing to make a fresh order defining more exactly some of the requirements—as, for instance, in the matter of the lights in private houses—and giving the police increased power to enforce it.

### Five Months' Local Loans.

Last Wednesday, Sir Edwin Cornwall asked the President of the Local Government Board if he could state the amount of loans sanctioned by his Department during the period March 26 to Aug. 31, 1915, during the same period in 1914, and each of the financial years ended March 31, 1913 and 1914.

Mr. Long, in reply, said: The amount of loans sanctioned by the Board during the period March 26 to Aug. 31, 1915, was £2,091,402, and during the same period in 1914 £7,412,277. During the financial years ended March 31, 1913 and 1914, the total loans sanctioned were £12,795,285 and £15,178,255 respectively. I should like to add that of the £2,091,402, over £1,350,000 was for war requirements—such as the provision of electrical and gas power, housing for munition workers, hospitals, &c.

# LEGAL INTELLIGENCE.

## APPLICATION REGARDING A MANTLE FABRIC PATENT.

### Position of a Berlin Firm.

Last Tuesday, in the London Patents Court, the Comptroller heard an application by Mr. Thomas Bromley, of the firm of Mellor, Bromley, and Co., of Western Road, Leicester, that patent No. 23,650 of 1903, held by Messrs. Henry Hill and Co., of Berlin, should be suspended or rendered void, by reason of the fact that it was held by an alien enemy firm. The patent is one for the manufacture of a machine for knitting fabric essentially for the construction of incandescent gas-mantles. The application was opposed by Messrs. Hill and Co.

Mr. Gordon, who appeared for Mr. Bromley, said the fabric which was knitted by the machine in question was of such quality that it had an exceptional reputation throughout the world. It was consequently greatly in request. It was a matter of much importance that the British market should be amply supplied with this fabric; but having regard to the fact that the licence for the patent of the machine which made it was held by a firm in Germany, this demand was not supplied. Therefore he asked that the licence should be suspended in his favour, so that his firm, who were perfectly able to do so, might manufacture the machine, and meet the demand for it and the fabric that it wove. The application was supported by the Volker Lighting Corporation and others.

Mr. Watson, for Messrs. Hill and Co., argued that the licence for the patent should not be suspended. In the first place, he said, it was not proved that the firm was an alien enemy firm—at least, it was not clear in the words of the Proclamation. Henry Hill and Co., of Berlin, was mainly run for the benefit of English shareholders. It was true that the majority of the share capital was held by an Austrian firm; but this firm was under the control of the United States Debenture Corporation, of which the shareholders were English.

The Comptroller: But the point seems to be that we cannot get the fabric for the mantles in this country. It does not matter how many shareholders are here in England, if the machine is made in Germany.

Mr. Watson: It all depends on who owns the patent.

The Comptroller: In ordinary times it might; but now it does not. What can English shareholders do if the machine is produced by Germans who cannot export it to England?

Mr. Watson said he could adduce evidence to show that the Welsbach Company were prepared to manufacture the fabric, and would meet the demand in this country, and that Messrs. Henry Hill and Co. were prepared to allow them to make the machine. The Welsbach Company were therefore masters of the situation; for they had it in their power to make the machine.

The Comptroller: This is the first I have heard of the Welsbach Company.

Mr. Watson: I ought to have said that the Welsbach Company really hold the controlling interest in the Austrian firm I have spoken of, subject to a charge on the shares which the United States Debenture Corporation have.

The Comptroller asked if the Welsbach Company were to apply for the licence?

Mr. Watson replied that he did not think so.

The Comptroller said it seemed from the evidence that the supply of this fabric for mantles was cut off, and therefore the demand must be met by some other means. Would it not be sufficient, even without evidence of any great demand, to show that the German Company who held the patent could not export the machine, to warrant him saying that the licence should be suspended in favour of somebody who could make the machine?

Mr. Watson thought not. He also argued that whatever demand there was for the fabric was fairly met, and that the evidence showed the demand for the machine was not such as would justify the suspension of the licence to the German Company.

Mr. Gordon, in reply, said the machine was used solely for the manufacture of the fabric in question. The evidence of Mr. Ashton, of the Volker Lighting Corporation, proved this, and that there was a great demand for the fabric. He suggested that there was no evidence to support the suggestion that the Welsbach Company could meet the demand.

Mr. Watson said he would ask for an adjournment to produce the evidence.

The Comptroller remarked that there was a question whether the Welsbach Company would not be infringing the patent if they produced the machine. After hearing other arguments, he said he would consider the matter and report in due course.

## LIABILITY OF PREPAYMENT METER CONSUMERS.

### Agreements Exempt from Stamp Duty.

At the Farnham Petty Sessions, on the 2nd inst., Mrs. A. Ward, of Ash, was summoned by the Aldershot Gas, Water, and District Lighting Company for payment of £2 7s. 5d. for gas supplied between Feb. 10 and Aug. 6 last.

It was stated that the prepayment meter through which the gas was supplied was in a lock-up shop. It showed that £2 8s. had been put in; but the meter had been broken open, and the money abstracted. An agreement accepting responsibility for safe custody of money in the meter-box, and undertaking to make good any deficiency found on collection, had been signed by the defendant, who did not appear to contest the case. The Magistrate's Clerk expressed the opinion that the agreement could not be produced in Court, as it was not stamped. If it were relied upon in connection with criminal proceedings, it would be a different thing. He read a letter from Mrs. Ward, in which she said that, as she had already paid for the gas, she was not in the Company's debt. Her husband was an officer at the front; and she had no separate estate. In the course of another letter, addressed to the Company, she said: "You fixed the meter in February last; and from that time you have never collected the meter-box money, although your people have repeatedly been requested to do so. One man did call and count the money, and returned it to the meter. What was the reason for the money not being collected monthly? Your people were frequently doing gas-stove repairs on the premises; and you knew the shop was a lock-up one." On behalf of the Company, it was explained that the reason why the money had not been collected was that a wrong address was given on the form. The meter was installed by another department of the Company at Farnborough; and the collector could not find the premises where it was fixed. The Clerk intimated that he had advised the Bench that the agreement could not be produced. It was for the Company to show that they had power to do so under their Act. That this might be done, the case was adjourned for a fortnight.

When the matter was mentioned again on the 16th inst., Mr. Norman Clinton, who appeared for the Company, said he believed the Clerk had meanwhile satisfied himself that the agreement was exempt from Stamp Duty, and therefore could be put in in evidence. The Clerk said that was so, though there was no case bearing directly upon the point. Mr. Clinton remarked that naturally a company like this, starting in a large way to supply gas by automatic meter, communicated with the stamp authorities, and were assured by them that no stamp was required. Therefore the agreement could be put in; and by this the defendant undertook to refund any deficiency in the meter money-box. Mrs. Ward had now paid the amount of the claim; and he asked also for the Court costs. These the Magistrates allowed.

**Synthetic Gas Processes.**—With a capital of £5000 [in 2500 preference participating shares of £1 each and 50,000 ordinary shares of 1s. each], Synthetic Gas Processes, Limited, has been registered to acquire any invention for the treatment of coal before or during carbonizing, to improve the yield of volatile products and the quality of coke produced, and the production of gases from coke, or the treatment of any products resulting from the carbonization of coal. It is a private company. The number of Directors is not to be less than two, nor more than three. The first are J. K. Welch, A. Rollason, and R. Doncaster (Secretary). The registered office is at No. 31, Station Street, Nottingham. Particulars of the process in which the Company are interested will be found in last and this week's issues of the "Journal" [pp. 635, 696].

# MISCELLANEOUS NEWS.

## SOME COMMERCIAL ASPECTS OF THE GAS BUSINESS.

### The American Commercial Gas Association's Contribution to the San Francisco Gas Congress.

Under this heading last week [pp. 653-5], abstracts appeared of such of the papers contributed by members of the American Commercial Gas Association to the International Gas Congress, San Francisco, as were at the time available. A few more have since been published; and they are abstracted below.

### Gas Street Lighting.

By GEORGE S. BARROWS.

The requirements for street lighting—viz., reliability, sufficient illumination, and appropriateness—are discussed.

The reliability of artificial gas as at present manufactured and distributed, when used with either open-flame or modern incandescent mantle burners, is shown to have attained a high degree of perfection. The various means for transforming the energy of gas into light by open-flame burners or incandescent mantles of different types, the means used for protecting the lamps by globes, and the methods employed for lighting and extinguishing lamps, are described. The utilization of high-pressure lighting is also briefly referred to.

The object of street lighting and means for attaining the ends sought are next enumerated.

Attention is called to the value of appropriate designs of lanterns and posts, and photographs of recent installations of gas-lamps, with data regarding the illumination of them, are given.

### Office and Store Lighting by Gas.

By THOMAS SCOFIELD and OSCAR H. FOGG.

Great advances have, the authors say, recently been made in the development of incandescent gas lighting. Until the last few years, there were but few sizes of incandescent lighting units on the market; but now there is a complete equipment of types and sizes of inverted and upright incandescent gas-burners at the disposal of the engineer. Coincident with these developments in burners, came a marked improvement in fixture design. Far removed from the old conception of "gas-fixture," as all that is ugly and inartistic, is the modern gas-fixture. Designs of gas-fixtures are now all that could be desired. Illustrations show the fixtures, for semi-indirect and direct lighting, that are adaptable for store and office lighting.

#### REQUIREMENTS FOR THIS CLASS OF LIGHTING.

In office lighting, "lighting" means correct lighting in a commercial sense, for which it has to be designed with regard to efficiency, quality of light, economy, dependability, and appearance. Modern gas lighting gives correct lighting, as the actual installations illustrated have conclusively proved.

Store lighting has the same general requirements as office lighting. More consideration has to be given to appearance than in office lighting; the quality and colour of the light, as a medium for the display of goods, are more important, and the dependability more necessary.

In addition to the elements of efficiency, quality, and colour of light, dependability of service and appearance, which are advantages of gas lighting particularly applicable to store and office lighting, there are many more advantages which this illuminant possesses that apply to all classes of lighting. Some of these are: Its acknowledged hygienic value, purifying the air; the fact that in radiant energy given off, candle power for candle power, it does not differ from electricity; the recently proved fact that it does not reduce the oxygen content of space illuminated; its flexibility and the means of distant control and ignition now available.

The requirements which have to be met, in the subdivisions of the main classification, and "how successfully gas is meeting them in most modern installations," are dealt with at length.

#### OFFICE LIGHTING.

The following classifications are those into which office lighting naturally divides itself (say) in a large office building:

General office lighting—Large office spaces for general clerical work.
Private office lighting—Small offices occupied by one, two, or three persons, board-rooms, &c.
Drafting room lighting.
Hall and corridor lighting.

*General Office Lighting.*—The illumination to be provided in this class is for clerical work over a large area; and general illumination is the modern solution.

The requirements are rather exacting. The intensity of illumination has been found to vary through a wide range, and also in respect to the system of lighting chosen. With the semi-indirect system, a slightly higher intensity is necessary. Generally, the range of 3 to 5½ foot-candles will cover any case in this class. Shadows have to be eliminated, and the illumination must be uniform and well diffused. These qualifications are obtained by the correct spacing of the semi-indirect or direct lighting units—much more effectively, however, with the semi-indirect units.

Specular reflection and glare are to be avoided. These are less liable to be produced with the incandescent mantle than with the modern electric incandescent unit. This is due to the low intrinsic brightness of the incandescent mantle, as compared with the incandescent electric unit—the ratio being 1 to 30.

The quality of the light is important, as concentration on fine work is often required. Gas is the least fatiguing illuminant to work under, and besides has great daylight qualities.

Illustrations are given showing clearly the use of gas for this class of office lighting. They are typical of the best modern practice, and illustrate the modern treatment of large general office spaces, with both the semi-indirect and direct lighting systems.

*Private Office Lighting.*—This class of lighting generally means the illumination of a comparatively small area occupied by a single person, although the same space may have two or three occupants and still be in the same class. It proves more exacting in its requirements than lighting a general office space—due to the personal preference of the occupant and other considerations. The intensity required is from 2½ to 4 foot-candles.

The general requirements are the same as for general office lighting. There are many reasons why wider variations occur in this form of lighting, besides those due to the personal equation of the occupant. A private office may be occupied by one person having one or two desks, and nothing else requiring a working intensity of illumination. The same size space may, in addition, contain filing cabinets, safes, maps, &c., along the walls, making a different lighting treatment necessary. If two or three persons occupy the same space, it will again change the layout of outlets, fixtures, &c.

Semi-indirect lighting, with its remarkable diffusion and softness, absence of glare, and decorative possibilities, is most satisfactory—although direct lighting, when correctly installed, is suitable and in many cases obligatory.

Illustrations show clearly how successfully the modern gas lighting equipment and accessories are meeting this wide range of requirements. These illustrations cover the divisions of private office lighting, as previously pointed out, and show semi-indirect lighting with both local control and pilot ignition, and magnetic control from the wall switch; also direct lighting, made necessary by local conditions, and semi-indirect lighting obtained from a multi-light direct lighting fixture, with bowl-shaped shades and small upright units.

*Drafting Room Lighting.*—This lighting is essentially the illumination of large areas similar to general office lighting; but it has a few requirements peculiar to itself. The intensity must be high, the diffusion perfect, and the distribution uniform. With the high intensities required, the absence of glare and specular reflection is very important. The quality of light is of extreme importance, in order to prevent eye strain. Modern incandescent gas lighting meets these requirements, especially with the semi-indirect system. The intensity in this class of work is found to vary between 7 and 10 foot-candles.

An illustration of a typical gas-lighted drafting room is shown. The semi-indirect system is used, and the illumination received on the drafting tables is 8 foot-candles.

*Hall and Corridor Lighting.*—The gas lighting of halls and corridors of office buildings presents few difficulties for solution. There are two divisions of this class of lighting: First, lighting the ordinary office building hall; second, lighting the main corridor containing special decorative features. In the first case, direct or semi-indirect lighting, properly designed, is entirely satisfactory. In the second case, the lighting units should be designed to form part of the decorative scheme. The intensities required vary from 5 to 2 foot-candles.

The characteristic of gas lighting which makes it especially suitable for this work is its close approach to daylight colour value; since it has to be used to augment daylight, and, therefore, gives the best possible effect.

Illustrations are given showing modern semi-indirect lighting applied to typical corridor lighting, and showing semi-indirect lighting with decorative units used to light a lobby.

#### STORE LIGHTING.

For the purpose of the paper it had been deemed best to make three general sub-divisions of store lighting—each one treated in a broad way, and a few typical illustrations given of gas lighting for each class. The following classification is used:

(1) Lighting of small stores.
(2) Lighting of medium-sized stores.
(3) Lighting of large stores.

*Small Stores.*—In this class will come such stores as art, book, cigar, music, notion, post-card, stationery and delicatessen stores, barber shops, bakeries, haberdashers, tailor shops, &c.

This type of store is generally owned by persons of limited means who require an economical lighting installation. On this point alone, gas has a great advantage over any other illluminant. Besides it has several other advantages, inherent in all forms of modern gas lighting; and for these reasons we find large numbers of small stores gas lighted, since gas can best meet the requirements of a simple, moderate-priced installation.

Each kind of store will have definite requirements peculiar to itself. Since this is true, and since local conditions play an important part, only the broadest statements can be made. The intensity of illumination required can be said to vary from 2 to 4 foot-candles. Usually the space to be illuminated is long and narrow, making one central line of lighting units most desirable. The direct or semi-indirect systems can be used; but direct lighting is in greater favour for this class of work. Some typical examples of small store lighting, by gas, are shown in the illustrations in the paper itself. These show both semi-indirect units and direct lighting units, of the large mantle inverted type, successfully meeting the requirements of this class of lighting.

*Medium-Size Stores.*—Under this classification will be found such stores as butcher, china, cloak and suit, confectionery, drug, grocery, hardware, hat, leather, piano, shoes, florists, millinery, &c.

As these stores are generally owned by persons better equipped financially than in the case of small stores, more thought can be given to the advertising and decorative value of the lighting installation, which can here be treated as part of the store furnishings. The interior of the store must be made attractive not only to those who have already entered, but to those glancing in from the exterior.

Gas lighting with modern units suits the conditions so well, that the authors find an ever-increasing number of establishments of this class becoming users of this means of illumination. Due to the artistic and attractive appearance of the gas semi-indirect units now on the market, this type of lighting is becoming very popular. It has proved to meet the requirements of medium-sized store lighting with entire satisfaction. Purely local conditions govern the intensity of illumination required;

but a range of 2½ to 6 foot-candles can be said generally to cover this class of work.

The modern treatment of these stores is clearly shown in a series of illustrations, which give examples of typical semi-indirect and direct lighting installations—"all of which not only furnish suitable illumination, but supply certain advertising features tending to draw customers into the store."

*Large Stores.*—Large stores will comprise such establishments as clothing, dry goods, furniture, furrier, jewellers, department stores, &c.

This class requires the most careful consideration of the advertising and decorative features of the lighting installation. Gas has successfully met these exacting demands, in most cases with the semi-indirect unit. But in some cases, due to local conditions, it has been advisable to use the modern direct lighting gas unit. One great advantage that gas possesses is its absolute reliability—giving no possibility of sudden failure of the lighting service on a busy evening. This has been realized, and, with the other advantages of gas lighting, has gained many installations in large stores. The intensity varies, but a general range is from 3 to 7 foot-candles.

The illustrations of modern gas lighting, in large stores, as prepared by the authors, "show clearly the popularity of this lighting medium, with both the semi-indirect and direct lighting units."

### Window Lighting.

Directly connected with the interior lighting of stores is the subject of show-window illumination. This class of lighting has peculiar requirements. The primary object is to make the display of merchandise the prominent feature. Again, the means of lighting must be concealed from view; and the goods must be lighted from the proper direction.

The intensity of illumination varies through quite a wide range. Since window lighting is purely an advertising feature, the intensities required can be said to fall within the range of 10 to 30 foot-candles—local condition and the colouring of the goods displayed influencing the intensity to be used.

The daylight value of gas is especially advantageous for show-window lighting, where the goods are best displayed in their true daylight colour values. With gas lighting for show windows, any of the forms of control and ignition can be used, as well as several forms of automatic regulators, which can be set to turn the window lighting off at any prescribed time. Convenience and flexibility of the gas units, with the advantage of colour value, have made them especially desirable for this work.

The two forms of installations now in general use are: First, the separate inverted gas units placed at the front and top of window, equipped with angle reflectors and hidden from the front by opaque material, such as a curtain; and, second, placing the units with conical reflectors over a transparent deck or false ceiling having translucent glass panels. In both cases the units should also be concealed from sight, when viewed from within the store.

The illustrations to this section of the paper show a few examples of good window lighting by gas, using the two methods.

### Conclusions.

Summing up their paper, the authors say they have endeavoured to discuss, in brief, the many different phases of office and store lighting in general; and it has been attempted to show how modern gas lighting can meet these requirements, while a few illustrations have been presented to show how successfully modern gas lighting is accomplishing these very things.

## Industrial Gas Lighting.

By Robert Ffrench Pierce.

The illumination of factories is a particularly fertile field for the sale of gas, since the refinements of control and the decorative possibilities which favour the selection of competitive illuminants in other fields are of little or no consequence in factories, while economy (the strongest competitive feature of gas lighting) is a weightier consideration than in any other class of illumination.

Manufacturers are being aroused to the economic benefits of good lighting, and are in a receptive mood. A recent census by the National Electric Light Association showed that 164 out of 209 manufacturers replying had recently made changes in their lighting systems, of whom 31 stated that their product had been improved in quality thereby, while 60 reported an increase in output. Only 7 stated that no results were apparent.

Reports of accident insurance companies show that faulty illumination is responsible for a large proportion of industrial accidents.

The increased expense of operating adequate lighting systems as against inadequate systems does not in the most extreme cases exceed 5 per cent. of the wages of the operatives, and is often actually less than that of the inadequate systems—due to the elimination of useless waste by scientific design, and substitution of more efficient appliances. In any event, a very small increase in production, with practically fixed operating expense, will justify any expenditure likely to be encountered in improving lighting conditions.

Although electricity is available to large factories at comparatively low costs, a careful analysis will usually show that an economy may be effected by the use of gas. Some of the largest and most efficiently operated modern factories have been converted to the use of gas for lighting by active cultivation on the part of aggressive gas companies, and under conditions which indicate that equal opportunities exist in most situations.

In order to secure marked beneficial results from the remodelling of a lighting system—results which will be apparent in the increased productiveness of labour—it is necessary to correct many glaring faults of practically universal occurrence in present-day practice. The worst of these is the production of eye-strain, due to glare from bright light sources or polished metal, woods, or other glossy materials. In general, it may be said that good practice demands that the brightness of light sources, visible either directly or by reflection from a glossy surface, should be as low as practicable.

It is necessary to observe proper spacing relations and care in the selection of size of lamp in order to secure adequate uniformity of illumination. It is rarely permissible to space lamps more than two and a half or three times the height above the working plane. The space above the level of the lamp should be sufficiently lighted to avoid unpleasant contrast with the light source.

General illumination of adequate intensity may usually be secured with a gas consumption of 0·01 cubic foot per hour per square foot of floor area, provided local illumination at machines, benches, desks, &c., is also provided. In the absence of local lighting, the gas consumption per square foot for general lighting should be increased to from 0·015 to 0·03—depending upon the class of work, &c.

Local illumination is applied to such a variety of uses that no general directions can be given. The proper arrangement may be determined by calculation or experiment. In all cases the shielding of the workman's eyes from the glare of the light source is the most important consideration.

The elimination of vibration is best secured by proper proportioning of pipe drop or brackets assisted by weighting, if necessary.

Due attention should be given to fire hazard and lamps protected accordingly.

Generally speaking, factory lighting business demands the attention of a specialist, if good results are to be anticipated.

## Semi-Public Lighting.

By T. J. Litle, Jun.

The author essays to show the recent progress in gas illumination, calling attention to the fact that indirect and semi-indirect systems are highly desirable on account of the low cost of this illuminant. Attention is drawn to the fact that semi-public lighting is a valuable publicity asset to the lighting company; also to the fact that the public criticizes and judges the merits of a lighting system largely through its public lighting. Attention is drawn to the desirability of obtaining sample semi-public installations on any new illuminant, in order that satisfactory conclusions may be drawn as to its acceptability by the public. The paper touches upon the fundamental principles to be observed in obtaining good illumination in such places.

The semi-public installations are classified, and suggestions are given for the proper types of units to be used in such places.

A new indoor unit is described which is equipped with three miniature mantles mounted upon an upright bunsen. This type of burner is destined, the author claims, to revolutionize incandescent gas lighting, not only because it readily meets various installation requirements (particularly on old fixtures), but also operates well on varying gas conditions; and the mantle losses heretofore encountered in transportation are eliminated because soft mantles are employed. A number of installations are then described and photographs of them given. Some of the installations are criticized as typifying poor illuminating engineering practice.

Outdoor lighting in such places as railway stations, &c., is touched upon and illustrations given. Other new units, such as the large size single mantle lamps and the single burner cluster units, like those used in semi-indirect fixtures, are described. The desirability of spectacular outdoor installations is explained, and the lighting of the tennis course and the golf putting course at the Woodbury Country Club is illustrated.

A great deal of stress is laid on the necessity for auxiliary lighting in all buildings where large numbers of people are apt to congregate—such as schools, churches, play houses, &c. A general outage in a single lighting system in such places at night when the building is crowded usually results in a more or less serious panic, and local authorities have in many cases made auxiliary lighting compulsory; it being explained that the auxiliary lighting be provided to furnish a certain proportion of the total illumination required and be used whenever the building is occupied at night—distinguishing it from an emergency system which might be brought into use should the main lighting system fail.

## Buoy and Car Lighting.

By George E. Hulse.

This paper describes the use of Pintsch gas and acetylene for the lighting of railroad cars and aids to navigation. It gives a brief history of the application of the gases to these purposes; the reasons for their special advantages for this work; and the method of manufacture of each. The necessary equipment for utilization is also described, together with the types of burners used, and the results obtained as to illumination and service.

# FACTORY AND WORKSHOP LIGHTING.

## Further Notes on the Appendices to the Committee's Report.

A continuation is now given of the notice of the appendices which accompanied the first report of the Home Office Departmental Committee on Lighting in Factories and Workshops. Earlier appendices were outlined in the news columns of the last two issues of the "Journal" [pp. 596, 657]; while two of them will be found reprinted in full on p. 643 last week, and pp. 706-7 of the present number.

### Lighting and the Eyes.

One of the appendices consists of a summary of replies from ophthalmologists and ophthalmic surgeons to several questions put to them by Mr. F. Richardson Cross, F.R.C.S., ; and some reference to these answers was made a fortnight ago [p. 565], in our "Electricity Supply Memoranda." The questions were sent to about 300 oculists or medical men interested in the subject, with a request for information; and the replies summarized were those which seemed likely to be of service to the Committee, or which suggested that trouble, or even slight ailments of the eyes, might sometimes be caused by insufficient or imperfect lighting. About nine-tenths of the whole number of answers indicated that the writers had no knowledge of mischief to the eyes as being directly due to defects in lighting. The evidence is therefore, it is remarked, negative as regards any definite damage to

the eyes being caused by faulty lighting. At the same time, it is quite obvious that good lighting is more comfortable to the worker, and would be likely to materially improve his output.

The questions asked were four in number. The first was: "Have you any statistics or opinions which will give information as to the prevalence of eye trouble, slight or serious, occurring in, or depending on, any trades of which you have special knowledge?" The next was, "Is any particular protection of the eyes advisable in any of these?" The third question was in these terms: "What arrangements for proper or artificial lighting are made in the workshops, and how would the illumination be practically improved in any special trades to the best general advantage of the workmen?" The final question was: "What kind of artificial illuminant is in your opinion the most satisfactory, and how is it to be best arranged, so as to avoid either shadow or glare?"

The substance of many replies was given in the previous reference to the matter, just alluded to. It was stated then that, "although gas lighting has such extensive use in factories and workrooms, there is not a single instance recorded of complaint having been made to the ophthalmologists of this system of lighting. Several of the replies, however, mention complaints of people working under the electric light." Mr. Allan Rutherford, M.B. [who deals almost exclusively with gross cases of irritation, such as Siemens and Bessemer steel making and other processes], has never met a case asking for compensation due to any eye disease from light or glare in the works; while Dr. P. A. Harry states that weaving is very trying with artificial light. Mr. M. Stephen Mayou, F.R.C.S., referring to his hospital work, mentions that compositors are particularly difficult to do anything for satisfactorily, owing to the nature of their work, which is often very badly illuminated. While admitting that he has not had experience with factories, Mr. Robert Jacques, F.R.C.S., expresses the opinion that there should not be a large contrast of shade with illumination in the same room. Light should be directed to the object observed, but shaded from the eyes. It is, he says, often overlooked that, while the work is brightly illuminated, the rest of the room is dark. He thinks the contrast leads to discomfort, which can be avoided by having the rest of the room moderately illuminated. Dr. F. W. Edridge-Green, F.R.C.S., too, urges that the lighting should be uniform, and strong contrast avoided. A bright light which can catch the eye is particularly to be avoided. In the opinion of Dr. A. S. Cobbledick, the position of the light is not enough considered; and its proper arrangement is very difficult where many clerks are working in one room.

A suggestion made by Dr. E. E. Maddox, F.R.C.S.Ed., is that compositors, who are apt to have gas-lights before their eyes only a foot or two away, should have them screened with small metal plates fixed to the burner, and reflecting the light on to the work. Speaking generally, Dr. Maddox thinks almost everything in a workshop should be whitened, and the lighting should be partly direct on special work and partly indirect; the source of light being shaded from the workers' eyes. The floor and benches should not be whitened, nor, if all the workers face in one direction, should the wall facing them be too white. On the same point, Mr. W. Beaumont, M.R.C.S., does not think enough use is made of the contrast of black and white. It is used in books—black type and white paper; but it should be carried further. The carpenter should have a black bench, and the lace-maker a black pillow, &c.

It is stated in the report that all answers to the fourth question deal practically with various applications of electric lighting—a point which, it may be recalled, was commented upon in the "Electricity Supply Memoranda" when dealing with the appendix.

### Fine Work and Eyesight.

A letter was addressed to five operative associations concerned with trades in which the nature of the work might involve injury to eyesight. In this letter, an invitation was extended to furnish the Committee "with the necessary information to enable them to trace among the members of the Association or elsewhere any specific cases of injury to eyesight caused by working with insufficient light or with a badly arranged system of lighting."

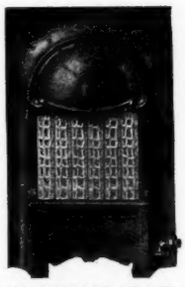
On behalf of the weavers, the Association stated that they were not prepared with specific cases of bad eyesight caused by bad lighting; but at various times complaints had been made by weavers at certain mills of having to follow their work under great difficulty, on account of the bad lighting. For the lace-makers, it was stated that a large percentage of superannuated members had quite good eyesight. In their time they would have had at least two lights to machines which were only two or three yards wide, whereas to-day machines five or six yards wide were being worked with only two lights, to say nothing of the additional speed of the machines.

### Illumination Measurements in Factories.

A number of records are given in one of the appendices, which were obtained during the winter months, at the instance of the Committee, in order to reveal as far as possible the lighting conditions under which some of the chief industries of the country are carried on at the present day. The actual observations were made by Mr. J. W. T. Walsh, B.Sc., of the National Physical Laboratory, and Mr. G. F. Sedgwick; and the Committee acknowledge their indebtedness to them for the thorough way in which they carried out their work. It is pointed out, however, that the records must not be regarded as giving more than a very general idea of lighting conditions in certain representative factories in the engineering, textile, and clothing industries. The relatively short period each day during which factories are working under artificial light affords only a limited opportunity for observations after dusk; but use was made of practically all the available time over which such observations were possible. Though they would have liked to be able to obtain a much larger number of observations, the Committee express the opinion that, for the chief industries studied, the average results now given would not in most cases have been much affected had a greater number of observations been available.

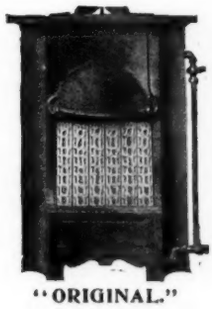
Previous to taking the measurements, a tour of inspection in each


# The MAIN D.S.O Fires



"DEPENDABLE."
(Reduced Type.)

"SYMMETRICAL."
(Reduced Type.)



"ORIGINAL."
(Reduced Type.)

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## R. & A. MAIN, LIMITED.

**WORKS:** Gothic Works, EDMONTON, N. Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
**SHOW-ROOMS AND BRANCHES:** 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

of the districts chosen was made by one of the Secretaries to the Committee, who selected factories both well and indifferently lighted. There were 54 factories dealt with, many of which were too extensive to permit of the taking of observations in all the rooms. The method adopted in these cases was to choose rooms which were as far as possible representative of the lighting conditions throughout the whole factory. In the main, attention was directed to the illumination of floors and gangways and at the point where work was being carried out; the measurements being made by placing the white test-card at the observation point and measuring the illumination. In the case of measurements in gangways and on floors, the card was placed on the floor at one or two representative positions. It is remarked that the illumination at any point by artificial light is in ordinary circumstances a fairly constant quantity. Though changes are liable to occur owing to fluctuations of the supply pressure, or to accumulations of dirt on the lamps and fittings, in well-regulated installations fluctuations due to such causes are not great; and the recorded observations may be taken as showing definitely the illumination at the various points by artificial light. With natural lighting, the matter is otherwise.

Measurements of the artificial illumination at floor-level were made in nearly all the factories visited. While it was found that in the majority of cases attention was paid to the general illumination of workshops by providing a certain number of lighting units for this purpose, in some instances no such provision was made—the lighting units being placed solely with the object of illuminating some point of work, and the floor illumination being left to chance. Sometimes this procedure yielded fairly good results in practice; but often it was found to lead to unsatisfactory, or even dangerous, under-illumination of certain parts of the rooms where no work was being carried on, but over which it was necessary for workpeople to pass. The mid-points of the curves—*i.e.*, the points above and below which equal numbers of observations lie—for floor illumination by artificial light in each class of factory visited are: Foundries, 0·4 foot-candle; engineering shops, 0·6 foot-candle; weaving sheds, 0·4 foot-candle; lace and hosiery factories, 0·35 foot-candle; clothing workrooms, 0·85 foot-candle; and spinning mills, 0·6 foot-candle.

Eleven weaving sheds were visited. In the majority of cases the lamps were shaded by enamel or opal shades of the ordinary shape. The usual method of placing the lights is to have one lamp over every pair of looms, or in cases where the candle power of the lamp is higher one over the centre of every group of four looms. The usual height of the lamps is from 5 to 7 feet—in other words, as low as possible without causing inconvenience to the operatives moving about under them. It is pointed out that with such an arrangement as this, it is clear that the ordinary form of shade is unsatisfactory on account of the glare due to the rows of bare lamps seen on raising the eyes from the looms. The improvement in this direction due to the use in some cases of metallic reflectors was very noticeable. The mean illumination at the loom varied in the different factories from 0·98 foot-candle to 8·7 foot-candles—the remark attached to the latter figure being, "Lighting very good." A curve embodying the results of all the observations on the looms "indicates a decided leaning towards an illumination of between 1 and 2 foot-candles at the surface of the cloth on looms;" while practically the whole of the floor-lighting curve lies below the 1 foot-candle point.

There were 22 rooms included in the observations of spinning, &c., processes—the systems of lighting met with including batswing burners, incandescent upright and inverted mantles, high-pressure gas, and electric glow lamps. In many cases where no special lights were provided to illuminate the gangways, they were found to be very badly under-illuminated. Observations made at the actual points of work varied from 0·11 foot-candle to 5·6 foot-candles. Curves prepared from rooms with machinery show that there is a considerable diversity in the values observed, with a tendency towards an exceedingly low illumination in many mills. Observations at spinning mules, while indicating less diversity, gave over 60 per cent. of tests below 0·5 foot-candle. Measurements at floor-level gave 22 per cent. of observations below 0·25 foot-candle, and 84 per cent. below 1·5 foot-candles.

In lace factories, ten rooms were visited, two of which were lit by electric incandescent lamps, four by high-pressure gas [in one case with a subsidiary system of electric lighting], and four by batswing burners. In the great majority of lace machine rooms the chief *desideratum* is a moderate general light over all the working parts, and the possibility of producing a high local illumination at any particular spot when required. For this purpose, the most suitable system of lighting seen consisted of counterweighted lamps, capable of being readily pulled down and directed towards any particular point which it was desired temporarily to illuminate. It is desirable that the lamps should be shaded. The one hosiery factory visited was lighted mainly by electricity; and the illumination produced seemed to be generally sufficient. But the lighting units were so placed that the workpeople, while tending their machines, were compelled sometimes to stand in their own light. An observation taken on the machine with the operative in his normal working position gave an illumination of 0·15 foot-candle, while the unobstructed illumination averaged 1 foot-candle. Here, again, more local lighting seemed desirable; and adjustable lights would undoubtedly have been a considerable convenience. The average floor illumination in this factory was about 0·5 foot-candle. A few observations in examining and mending rooms showed that the illumination varied from 0·3 foot-candle to 4·5 foot-candles, with an average of 2 foot-candles. The mid-points of the curves are approximately: Lace machines, 0·7 foot-candle; lace factory floors, 0·35 foot-candle; hosiery machines, 1·3 foot-candles; winding machines, 1 foot-candle.

The total number of general engineering shops [excluding foundries] in which measurements of artificial illumination were taken was 43; and the lighting systems met with included batswing burners, ordinary upright and inverted incandescent gas, high-pressure gas, electric glow lamps [used both for local and for general lighting], and arc lamps. It was noticed that as a rule the same general system of lighting prevailed throughout all the shops in each factory. In several factories


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The ventilating air is drawn in from all parts of the room, but over a considerable surface, and is *not therefore brought to a draught-creating focus.*

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where arc lamps were used, the lights seemed to be hung too low to give the most satisfactory general illumination. In this way, "dense black shadows were often formed;" and in one instance these were complained of. There was also one complaint of glare, owing to the low position of the lighting units. When electric glow lamps were used for local lighting, "they were often, but by no means always, efficiently shaded." The shades used for the lamps illuminating vices, and for bench work generally, were mostly of the ordinary enamelled iron form. It is remarked that probably in many cases parabolic or similar specially designed shades would give more satisfactory results. For illuminating machines, such as lathes, where the local light had to be close to the work, the most satisfactory kind of shade appeared to be of a conical form. The measurements of illumination at the point of work covered a very wide range. A curve relating to machine work shows that there is no very definite illumination which is regarded as the best for this kind of work. While about one-third of the observations were below 1 foot-candle, there was an equal proportion above 2·5 foot-candles. So that the middle one-third of the observations were between these figures. Approximately 8 per cent. of the observations were above 10 foot-candles. In connection with bench work, the observations were so distributed that approximately one-third were below 1·25 foot-candles, one-third between 1·25 and 3 foot-candles, and the remaining one-third all above the latter value. This distribution indicates that bench work is allowed a higher degree of illumination than machine work. There were 6 per cent. of the observations above 10 foot-candles. The curve for heavy work—such as forging, spring making, rolling, &c.—is somewhat indefinite, owing to the limited number of observations available; but the uncertainty indicated by the two previous curves as to the degree of adequate illumination does not appear here to the same extent. Over 50 per cent. of the observations were between 0·75 foot-candle and 1·75 foot-candles. The curve for floor illumination in all classes of machine-shops shows only about 24 per cent. of observations above 1 foot-candle or below 0·4 foot-candle; so that an illumination between these limits is that most commonly met with. The mid-points of the different curves are approximately: Machine work, 1·6 foot-candles; bench work, 1·8 foot-candles; heavy work, 1 foot-candle; and floors, 0 6 foot-candle.

The artificial lighting of eighteen foundries was investigated. The main system employed was arc lamps in eight cases, high-pressure or ordinary incandescent gas in three, electric glow lamps in four, and batswing burners in three. Seven of the foundries had local lighting by gas and electricity, in addition to the main system. In many instances the lighting seemed generally sufficient; but it appeared particularly bad in those foundries lit mainly by batswing burners, some parts of which were clearly dangerous. The chief disadvantage of lighting by isolated powerful sources—especially in foundries with low roofs—is, it is remarked, the dense black shadow cast by every object in the neighbourhood of a lamp. This makes it extremely hard to see the nature of the ground which happens to be in such a shadow; and it has been stated that accidents arise from this cause. It is particularly necessary that the passages and gangways of foundries should be well illuminated; otherwise there is always some likelihood of treading upon hot metal which has been spilt in transit, but is no longer visible by its own incandescence. Measurements taken at the floor or other place of moulding or casting ranged from 0·19 foot-candle to 2·3 foot-candles. The mid-point is approximately at 0·4 foot-candle.

The total number of clothing workshops and sewing rooms in which measurements were made was 37; and the lighting systems met with included batswing burners, upright and inverted mantles, glow lamps, and indirect lighting by inverted arcs. Good results may be obtained from any of these systems except the first. With sewing-machines, the light-sources were generally placed several feet away from the point of work; one source often serving to illuminate several machines. In only two factories was any attempt made at systematic localized lighting. In one of these, a small electric glow lamp in a metallic reflector was fixed to each machine close to the work, so that the light was directed almost entirely on to the needle of the machine or its immediate neighbourhood; in another, an electric lamp with enamel shell shade was provided for each machine on an adjustable arm. In only one room were deep metallic reflectors fitted so as effectively to screen the lamps, which in all other instances were either unshaded or else fitted with opal or enamel shades of the ordinary shallow conical shape. The uncomfortable and glaring effect of this arrangement of lamps was referred to when dealing with weaving sheds. The mid-points of the curves for the lighting for different kinds of work are approximately: Sewing upon coloured materials, 3·6 foot-candles; cutting and pressing, 2 foot-candles; sewing on white linen, 2·5 foot-candles; and floors, 0·85 foot-candle.

In seventeen unclassified rooms, in which observations were made, the systems of lighting met with included batswing burners, inverted mantles, and electric incandescent lamps. The illumination at the point of work ranged from 0·25 foot-candle to 8·4 foot-candles.

### Daylight Illumination.

The observations dealt with here, of course, refer only to artificial lighting conditions; but similar measurements were made in daylight. The next appendix also deals with the latter aspect of the question; but it is unnecessary to complete this notice of the appendices to the report by any detailed account of what is set forth. Messrs. C. C. Paterson and J. W. T. Walsh remark that the proportion of outside light reaching a point inside a building is seldom as much as one-tenth, and more often lies between one-hundredth and one-thousandth. That is to say, the illumination outside a building may be a thousand or more times as great as that simultaneously existing within. In spite of this very large difference, however, it will be found that on a bright summer day, when the outside illumination is of the order of 5000 foot-candles, work can be quite comfortably carried on at a bench within a building where the illumination is only one-thousandth of this amount. Furthermore, the eye does not perceive a very marked difference in passing from outside to inside the building, or *vice versâ*.

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## DUTCH AND GERMAN INCANDESCENT MANTLES.

**[From the "Ironmonger," Sept. 25.]**

In an editorial article in the "Ironmonger" of July 10,* we questioned the right of the N. V. Gautsch Gasgloeilicht Maatschappy (Incandescent Gas-Mantle Company), of Amsterdam, to be regarded as a business of Dutch nationality. The Company sells a considerable part of its output to a few large buyers in this country; and our information was that the money paid to it went, not into Dutch but into German pockets. We alleged:

1. That the business was a branch of a German company.
2. That its shares were in German hands.
3. That its chief proprietor was actually serving in the German Army.
4. That the works had been erected in Holland since the outbreak of war.
5. That twenty-five young women were brought over from Germany to manufacture the mantles in Holland.

Our statements brought us a letter from Mr. C. Engel, the Managing-Director of the Company, which appeared in our issue of July 31.† Mr. Engel declared that practically the whole of the share capital of the Company was owned by Dutch subjects; that "the young Mr. Gautsch" who is serving in the German Army was not connected with the business in any way; and that the business had been established in Holland twenty-five years or more. In view of these positive disclaimers we felt that a frank apology was due to the Company; and we published such an apology unasked in the same issue in which appeared Mr. Engel's letter.

Further information which has reached us causes us to return to the subject now—not to question the truth of Mr. Engel's assertions, so far as they go, nor to deny that some of the assertions made in our article of July 10 were inaccurate and misleading, but because it appears to us that, if the Company wishes to continue to sell its goods in the British market while a state of war prevails, it is desirable that some further light should be shed upon its operations and its business connections.

It appears that the late Mr. Carl Gautsch was a German who settled in Holland in the year 1879, and after various ups and downs started a business in incandescent goods about the year 1889. This business apparently consisted purely—at the beginning, at any rate—in importing such goods from Germany and selling them in Holland and in England. It was, in fact, a merchant's business. Mr. Gautsch married a Dutch widow, a lady of means. Whether he was ever naturalized in Holland, we do not know. In the year 1905 he converted his incandescent-mantle business into a limited liability company, with a capital of 250,000 fl. (about £21,000), and with himself as Managing-Director. He retired from that position in 1909, and in 1913 he died. The bulk of the shares in the Company now appear to be in the hands of Mr. Gautsch's widow, who survives him, and of her daughter by her first husband. Mr. Engel, who is a Dutchman, is Managing-Director of the business. The Mr. Gautsch who is serving in the German Army appears to be a nephew of the originator of the business, and was, we understand, in the employ of the Company until he was called up for service.

The present undertaking of the Company includes a large incandescent-mantle factory at Sloterdyk, on the outskirts of Amsterdam, employing over a hundred hands. The workers, we are informed, are principally of Dutch nationality, although several responsible employees are German. There is also a lamp-works at Zalt-Bommel, in Holland; but this is a small affair, in which no more than about twenty people are employed. We appear to have been accurate in stating that the Sloterdyk works were started since the war began. In fact, it seems that it was the shutting-out of German mantles from direct exportation to the British market that caused the management of the Gautsch works to take a lease of the premises. Mr. Engel's contention that "this modern factory, completely fitted up according to the latest principles, was not merely put up to serve during the war," may be quite correct; but it is equally correct, we think, to say that if there had been no war there would have been no "Amsterdam Little-Glow-Stocking Factory" (to translate the quaint Dutch style of the works literally) at Sloterdyk.

The Dutch nationality of the principal shareholders in the concern, of the Managing-Director, and of the majority of the workpeople, may be admitted to be established, and so is the fact that manufacturing operations on a large scale are carried on at the works, and that the Company is a reputable and well-established undertaking. The points upon which further enlightenment is desirable are these:

Was the Gautsch firm acting as agent for the Auer Company, the great German incandescent firm, up to August, 1914?

Did the Auer Company in August and September, 1914, send to the Gautsch firm large quantities of machinery, very large quantities of raw material for the manufacture of incandescent mantles, and particularly of thorium, and a number of German artizans skilled in the manufacture of incandescent goods?

Does this machinery form part of the present plant at the Sloterdyk works; has the raw material been used there for manufacturing purposes; and are the German artizans employed there now, or have they been so employed since the war began?

Is it a fact that, soon after the Auer Company had consigned the aforesaid large quantity of thorium to Holland, the German Government prohibited the exportation of thorium, and that

* Reproduced in the "JOURNAL" for July 13, p. 91.

† An almost identical letter was addressed to the "JOURNAL," and appeared in our "Correspondence" columns of July 27, p. 194.


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Complete with **8-in. Enamelled Iron** Reflector, Globe (Round or Pear), and Mantle.
Price **6s. 9d.** each.

Complete with **12-in. Enamelled Iron** Reflector, Globe (Round or Pear), and Mantle.
Price **7s. 3d.** each.

Price of Round Globe with Bayonet Fixing.
**Clear, 18s. 6d.** doz. **Obscured, 19s.** doz.
Wire Guards, **10d.** each.

**MADE FOR LOW OR HIGH PRESSURE.**

## THE BLAND LIGHT SYNDICATE, LIMITED,

**LONDON and MANCHESTER.**

the Government Commissioner who issued the prohibition is a Director of the Auer Company?

Finally, has the Gautsch Company any connection, direct or indirect, with the German Auer Company?

It is said that almost the whole of the products of the Gautsch Company are sold to a few British firms, and we understand that in authoritative quarters much interest is felt in the matter of the firm's supposed relationships with the Auer Company. A representative well known in the incandescent-light trade of this country has recently been sent by the British Government to Holland to investigate the incandescent mantle trade generally, and particularly to find out whether any relations exist between the Gautsch Company and the German Auer Company, and, if so, what they are. The report of this representative, which is shortly expected, should help to clear matters up.

## WAR BONUS QUESTION AT OLDHAM.

### Gas and Water Workers Tender "Sympathetic" Strike Notices.

Over 500 notices to cease work were tendered to the Town Clerk of the Oldham Corporation last Wednesday, on behalf of the members of the Gas-Workers' Union. The departments principally affected are the gas and water; and these aggregate nearly 800. A fortnight's notice is necessary before work can be relinquished.

The Town Council, on a general application for an advance in wages to the lower-paid workmen, granted an advance of 2s. per week to men earning less than 30s., and such advance as would not bring their earnings to more than 30s. per week. Men earning 30s. and upwards were not to receive the advance, except those who had had an increase automatically by advances being granted to skilled men employed in similar work in the district. A ballot was taken of the members of the Union on the question as to whether they were in favour of the tendering of notices to the two Committees to cease work, in order to obtain advances for all workmen. The voting resulted in an instruction to send in the notices.

With the notice was enclosed a statement by Mr. J. R. Clynes, M.P., General Secretary of the Union, in which he said there were about 300 men in the Gas and Water Departments who, by exceptional service, could earn more than 30s. per week; and no settlement could be reached if these men were deprived of any advance similar to that which might settle the claims of other workmen. The men had felt themselves driven to tender notices because the Corporation had declined either to submit the claim to arbitration or to agree to a conference which had been suggested. With few exceptions, the whole of the wage-earning classes in Oldham had already received advances. Many other corporations in Lancashire and the country generally had given advances to all their workmen; and Oldham men could not submit to worse terms than other places. The Corporation had already given an advance of 3s. to all the higher paid artizans in the skilled trades suffering from the heavy increase in the cost of living. Where more than 30s. was earned, it was not because of ordinary labouring service, but because of special skill or additional work on Saturdays, Sundays, and night-shifts. Corporation workers were willing to share any burden that advances to workmen might entail, but were not willing to forfeit their right to advances most other ratepayers had now obtained.

## COKE AS A MOTOR FUEL.

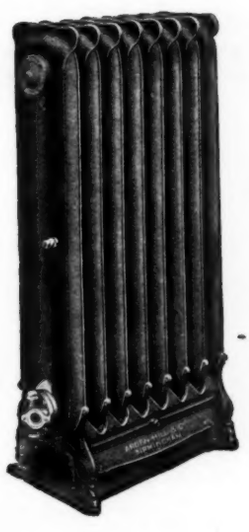
Drawing attention to the claims of coke as a fuel for steam-waggons and tractors, the "Commercial Motor" points out that its heat value is but some 14 per cent. lower than that of the best Welsh steam coal; while not only is Welsh coal high in price and likely to remain so, but some sorts are distinctly inferior in quality to those which were available at the outbreak of war. So far as our contemporary can see, "coke is likely to remain low in price, by reason of the virtual cessation of export in not a few directions. The keenness with which the London Coke Committee are arranging to establish depôts in and around the Metropolitan area augurs well for the future of this fuel. The threat of additional taxation upon motor spirit, which cannot fail to revive interest in the alternative of steam-wagons and tractors, will undoubtedly help the numerous gas undertakings which have at last fully realized that a big potential market is open to them. Welsh coal has many and admitted advantages; but we can write from experience, with fleets of steam-waggons which were worked solely upon coke, that the claims of Welsh steam coal must not be wrongly elevated to the point of becoming a fetish. If half the steam-waggons and tractors in the country worked on coke, a consumption of more than 3000 tons a week should be the experience."

In an article on the subject of motor fuels, "Motor Traction" points out that the grading of coke is now well organized by most of the important Metropolitan and Provincial gas companies for steam-raising and other purposes. The grade giving the highest rate of combustion with a minimum of draught is that which will pass a 2-inch square mesh screen and over a ¾-inch screen of the same section. The writer says: "With the development of the water-tube boiler, the use of gas coke as fuel becomes practicable, owing chiefly to the larger proportion of grate area per unit of effective heating surface usually provided with this type of boiler; and now, after many years of pioneer experimental work, the coke-fired water-tube boiler has definitely established its claim to recognition. That there are thus two kinds of smokeless fuel available for the steam-driven vehicle, both being home products, is matter for satisfaction. This fact removes the uncertainty as to supplies in the future which attaches to the petrol motor, and the possibility of combinations of proprietors imposing unreasonable prices, as one is a natural and primary product of the coal-mining industry, while the other is an unavoidable bye-product of coal-gas manufacture."

THERE MUST BE MANY LARGE BUILDINGS in your DISTRICT where the

"MARS" GAS-HEATED STEAM RADIATOR

is needed to maintain a comfortable temperature during the coming winter.



The outstanding advantages of the "MARS" are

Small Cost to Instal
Low Gas Consumption
Can be placed anywhere
Needs only a Gas Connection
Flueless! Odourless!

Made in 26 different sizes to suit varying requirements.

ARDEN HILL & CO., Acme Works, BIRMINGHAM.

## NOTES FROM SCOTLAND.

### From Our Own Correspondents.

*Saturday.*

At a meeting of the Special Committee on Coal Supplies appointed by the Corporation of Glasgow, a deputation was received from the Lanarkshire Coalmasters' Association, who explained the effect of the Price of Coal (Limitation) Act, 1915, on prices at the pithead. The view expressed by the deputation was that the full maximum allowed by the Act would be added to the prices existing in the corresponding periods of 1913-14. It was remitted to the Convener and Clerk to prepare a report and recommendations to be submitted to the Corporation, after approval by the Committee.

Estimates for the current year, submitted to the Gas Committee of the Perth Town Council by ex-Bailie Wright, the Convener, showed that it was intended to retain during the whole of the period the price of gas at 3s. 6d. per 1000 cubic feet, and not make an increase of 6d. in November, as had been anticipated. This satisfactory result, he said, had been obtained by the unexpected reduction in the price of coal, owing to the rebate which will be received under the Prices of Coal Act passed in the last session of Parliament, and also by the increased revenue obtained from residual products. For trade purposes, the price of gas is to be fixed at 2s. 11d. per 1000 cubic feet, with discounts varying from 2½ to 10 per cent. on consumptions ranging from 100,000 to 1,000,000 cubic feet per annum.

At a meeting of the Valuation Committee for the County of Aberdeenshire—Lord Provost Taggart presiding—an appeal was heard of the Aberdeen Parish Council against the proposed valuation of £11,566 on the Aberdeen Gas-Works. They asked that the sum should be fixed at £20,226. The Lord Provost intimated that the Magistrates, having heard the arguments of the parties and considered the matter, were of opinion that the decision in the Arbroath case confirmed the practice of arriving at the rent or annual value on the basis of the revenue of the preceding year, and accordingly sustained the entries made by the Assessor, and dismissed the appeal. The Magistrates, on application by the Council, agreed to state a case.

The Thurso and North of Scotland Gas Corporation, Limited, have appealed against the valuation placed on their undertaking, and have had it reduced by £132. Mr. J. B. Scott, the Manager of the Cowdenbeath Gas-Works, appeared on behalf of the Corporation. Mr. Scott also appeared for the Oban and District Gas Company, who, as recorded last week, were successful on appeal in getting their assessment reduced by £100.

A complete reconstruction has been effected at the Maybole (Ayrshire) Gas-Works. A new retort-bench has been erected, of three ovens—two containing five retorts each, and six retorts in the third. They have been fitted throughout with new mouthpieces, ascension-pipes, and steel hydraulic main; also a steel foul-main round the retort-house, carried by wrought-iron hangers from the roof principals. The foul-main is furnished with a new steel valve, and carried outside the retort-house and connected-up to the condensers. The condensers have been reconstructed, and raised 2 feet above the ground level, and thereby rendered more accessible for cleaning purposes. The retort settings are of the most modern type, on the shallow regenerative principle; the hot coke being drawn direct into the furnace below through a steel shoot. The cost of the reconstruction has been £1000. The work was carried out by Messrs. R. S. Workman, of Saltcoats, to plans prepared by Messrs. Fairweather, of Kilmarnock.

At their meeting last Monday, the Aberdeen Town Council had a prolonged debate on the question of increasing the charges to the electricity consumers. The Electricity Committee recommended that the increase be 15 per cent. all round. The Council, however, by 20 votes to 10, rejected the Committee's recommendation, and decided that the charge for current for lighting (including public lighting) be increased by 10 per cent., and the charge for motive power (including heating and lighting) be increased by 25 per cent. A letter was read from the Board of Trade pointing out the importance of every effort being made at the present time to accumulate stocks of coal, as, owing to the number of miners who have joined the colours, the supply of coal for home consumption next winter will be less than usual.

## CURRENT SALES OF GAS PRODUCTS.

### The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Sept.* 27.

There is nothing of particular interest to record in the tar products market, and values generally are about the same as last week.

Makers' quotations for 25 per cent. sulphate of ammonia remains unaltered at £14 8s. 9d. per ton net, filled into buyers' bags, at makers' works.

### Tar Products in the Provinces.

*Sept.* 27.

There is little alteration in the markets for tar products. Pitch still keeps quiet, and transactions are few. Solvent and heavy naphthas are in good demand. Creosote is still very quiet, and reasonable prices are being accepted.

The average values of gas-works products during the past week were: Gas-works coal tar, 21s. 3d. to 25s. 3d. Pitch, East Coast, 21s. 6d. to 22s. per ton; Norfolk, Suffolk, and Humber ports, 19s. to 20s.; West Coast, 20s. to 21s. Manchester; 21s. to 21s. 6d. Liverpool; 22s. to 23s. Clyde. Benzol, 90 per cent., North, 10½d. to 11d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 2d. to 2s. 4d. Coal tar crude naphtha, in bulk, North, 6½d. to 7d. Solvent naphtha, naked, North, 1s. 11d. to 2s. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2⅞d. to

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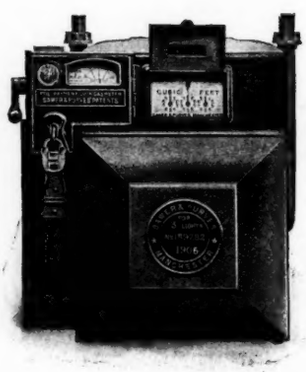

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### Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Sept.* 25.

During the past week the market for this article has been very quiet, and at most ports lower prices have been accepted. Direct orders from buyers abroad have been scarce, and dealers have evidently had sufficient supplies in hand to meet their present requirements. The closing quotations are £14 8s. 9d. per ton f.o.b. Hull, £14 11s. 3d. f.o.b. Liverpool, and £14 13s. 9d. f.o.b. Leith. The dullness in the near position has now affected forward delivery, and it is reported that business has been done f.o.b. good ports at £14 12s. 6d. per ton for October-December, and at £14 17s. 6d. for January-June.

### Nitrate of Soda.

This market has remained firm throughout the week; and although the value of ordinary quality is still 13s. 4½d. per cwt., that of refined has advanced to 14s. 4½d. per cwt.

### Sulphate of Ammonia.

From another source it is stated that there has been no alteration in the market during the past week, although in some quarters lower prices are reported to have been accepted. Outside London, makes are quoted at £13 17s. 6d.; Hull, £14 7s. 6d.; Liverpool, £14 7s. 6d. to £14 10s.; Leith, £14 12s. 6d.; Middlesbrough, £14 7s. 6d. to £14 10s.

## COAL TRADE REPORT.

### Northern Coal Trade.

The coal trade seems rather stronger; and the prices are firmer in some cases. Licences to export appear to be more freely given, though steamers are still somewhat scarce. In the steam coal trade, there have been some governmental orders placed, which are making collieries a little brisker. Best Northumbrian steams are from 17s. 6d. to 18s. per ton f.o.b.; second-class steams are 16s. to 16s. 6d. per ton; and steam smalls are quiet and plentiful in the supply at 12s. to 14s. per ton f.o.b., according to the quality. The output is now more nearly taken up than it was; and the pits are working full time, except in a few instances. In the gas coal trade, the demand is now steadily growing, both for home and foreign needs. Best Durham gas coals are quoted at 19s. per ton f.o.b., and this price has been paid for early delivery. Second-class qualities are steady at 16s. 6d. per ton; and a contract for coal of this class is reported for the next three months at 16s. 6d. for a fair quantity. "Wear Specials" are firm at 20s. to 20s. 6d. per ton f.o.b., and deliveries are fairly good. With the increase in the home demand, and some improvement in the exports, the gas coal trade seems to be a little more promising than it has been. But the rates of freight are higher—9s. to 9s. 6d. being paid for gas coal Tyne to London; and at even the higher of these figures there have been fixtures. The coke trade seems to be steadier, with fuller exports. Good gas coke is a little more plentiful; but 28s. 6d. to 30s. per ton f.o.b. from the Tyne is still quoted.

**Rise in Price at Whitby.**—The Directors of the Whitby Gas Company have given notice to consumers that, as from the 1st prox., the price of gas will be increased 2d. per 1000 cubic feet, to 3s. 9d. This step has been forced upon the Company by the increased price of coal which is having to be paid. Fractional parts of 1000 cubic feet will be charged as follows: 100, 5d.; 200, 9d.; 300, 1s. 2d.; 400, 1s. 6d.; 500, 1s. 11d.; 600, 2s. 3d.; 700, 2s. 8d.; 800, 3s.; 900, 3s. 5d. The quantity of gas supplied through prepayment meters for 1d. will be 19 cubic feet.

**The Modern Gas-Fire.**—In the course of his annual report as Chief Sanitary Officer for the Borough of Keighley, Mr. J. C. Dawes expresses the opinion that the enterprise of the Gas Committee in introducing into the town the latest and perfectly hygienic gas-fires has had something to do with a diminution of the smoke nuisance from domestic chimneys. These gas-fires are, he says, splendid; and a large number of them have been fixed. Those in use will be the cause of many others being purchased, so successful are they as heat producers. The new gas-fire is a great improvement on the older one, and is a source of much pleasure. Another important point about the hygienic value of gas-fires is that the gaseous impurities of coal are removed from the gas before it is delivered to the house; whereas with a coal-fire these impurities are poured out from the chimney top, not only being wasted, but in their turn destroying the surrounding vegetation.

**Road Repairs at Okehampton.**—At a meeting of the Okehampton Rural District Council, the Surveyor complained of the way in which the roads were being restored at North Tawton by the Devon Gas Association, who had been searching for leaks. He thought the gas-main at North Tawton was very unsatisfactory—being in some places only 12 inches below the surface of the road. He did not think it was possible for the Association to reinstate the roads in their original condition. The Clerk said the Association had written complaining of the loss of gas by leaking mains caused by heavy steam-rollers being taken over the roads. They were, therefore, given permission to break-up the roads to try and discover the leakage, provided they were reinstated to the satisfaction of the Surveyor. Mr. Whipham remarked that it was usual for the Council to do the work, and for the Gas Company to pay for it. It was decided to ask Mr. George Lane (the Secretary of the Association) to confer with the Surveyor.

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## Doncaster Gas and Water Accounts.

The abstract of accounts just published by the Doncaster Borough Accountant (Mr. C. Hanson) shows that in connection with the gas undertaking the income during the year ended March 31 last was £53,149, as compared with the previous year's total of £51,864; while the respective totals of expenditure were £48,322 and £44,797—last year's surplus being £4827, as against £7067 for the preceding year. In connection with the water-works, the income was £25,824, as compared with the previous year's total of £24,771; while the respective totals of expenditure were £22,815 and £21,801—leaving a surplus of £3009 for the period under review, as compared with £3969 for the twelve months ending March, 1914. The amount paid to the Sheffield Corporation for interest, sinking fund, maintenance, and additional supply in connection with the Little Don Valley works was £9857, against £8789 during 1913-14. The unexhausted borrowing powers in connection with the water-works is £2200, and those in relation to the gas-works £1620. Upon the first-named undertaking there is £261,783 outstanding for loans; the gas-works' figure is £79,650.

**Dearer Gas at Sittingbourne.**—The price of gas at Sittingbourne is to be increased to 3s. 11½d. per 1000 cubic feet—a rise of 2½d.

**Increased Price at Goole.**—It has been decided by the Goole Urban District Council to increase the price of gas from 3s. to 3s. 6d. per 1000 cubic feet.

**Truro Gas Company.**—Mr. J. James, presiding at the annual meeting of the Truro Gas Company yesterday week, said the dislocation of business brought about by the war had caused a reduction of income. It was only by the utmost vigilance that the supply of gas was maintained without restriction. Had they not held large stocks of coal and made fortunate purchases, there would have been a considerable increase in cost. At present they were paying 13s. 1d. per ton more than in 1911, which represented about £3000 per annum. Of this amount they would receive about one-half, through the increase in the price of gas. A new installation of vertical retorts had been brought into use the previous week, and so far it had worked satisfactorily. Dividends of 5 per cent. on the preference shares and 3½ per cent. on the ordinary stock were declared. Mr. S. J. Ingram (the Manager), replying to a vote of thanks, said the year had been exceptionally trying. There was not now remaining in the office a single member of the clerical staff who was with them in August last year; and more than 50 per cent. of the employees at the works had joined the Colours, and had been encouraged in every possible way to do their duty to the country. The installation of vertical retorts which had been put in unfortunately had German parentage; but only about £250 worth of the material was of German origin. Purely British labour was employed in the erection; but certain patented parts were German. It was working with success, and he had no doubt would quite fulfil the stringent guarantee given by the contractors.

## Suspension of Gas-Appliance Hiring at Oldham.

Controversy may arise as to the wisdom of the decision of the Oldham Corporation Gas Committee to curtail the supply of gas-cookers and gas-fires to their consumers during the period of the war. At a meeting of the Committee last Wednesday, Mr. Arthur Andrew (the General Manager) submitted a report in which he recommended that the supplying of gas-stoves and gas-fires should be suspended during the war period. This, he said, was advisable in order to comply with the request of the Local Government Board that municipalities should economize wherever it was possible to do so. On a previous occasion, the Committee did not arrive at any decision; and he therefore now renewed the recommendation. He explained that, since the matter was last before the Committee, he had had an opportunity of speaking to the Chairman, who was not now opposed to the recommendation. The capital cost was between £1000 and £2000 per year. The expense of fixing cookers and fires was obtained from revenue. The department could receive applications for cookers and other appliances, if people chose to make them; but they would be held over. He suggested that the show-room should be kept open; it could be used to some extent as an office. The recommendation was adopted. Another recommendation was that the men from the distributing side of the department (outdoor workers, &c.) should be drafted into the works for the winter, instead of engaging additional labour, as is usual at this time of the year. Mr. Andrew spoke in favour of the proposition, and the Committee approved the course suggested.

**Bland Light Syndicate.**—At the seventh annual general meeting of this Company, recently held at Little Trinity Lane, E.C., the Chairman (Mr. F. J. Gould) announced that the year's trading, in spite of many difficulties, had been a satisfactory one; and, as far as the Board were able to foresee, there was not any likelihood of the Company being adversely affected by the war. An interim dividend at the rate of 6 per cent. per annum for the six months ending Oct. 31, 1914, was paid in July last; and it was decided to make a further distribution at the rate of 10 per cent. per annum—giving a dividend of 8 per cent. for the year.

**Lighting of St. Columb.**—A letter from the Secretary of the Gas Company was read at the last meeting of the St. Columb District Council, protesting against a resolution passed by the Council at a previous meeting to decrease the hours of public lighting. The Secretary said that, in entering into a provisional arrangement last March for a renewal of the lighting contract for three years, the Company and the Council came to a distinct understanding that there was to be no curtailment of the hours; and the Company could not recognize the right of the Council to vary the conditions. Unless the Council were prepared to revoke the resolution, the Company would, at the end of three months, cease to supply gas to the public lamps. The Council decided to receive a deputation from the Company at a future meeting.


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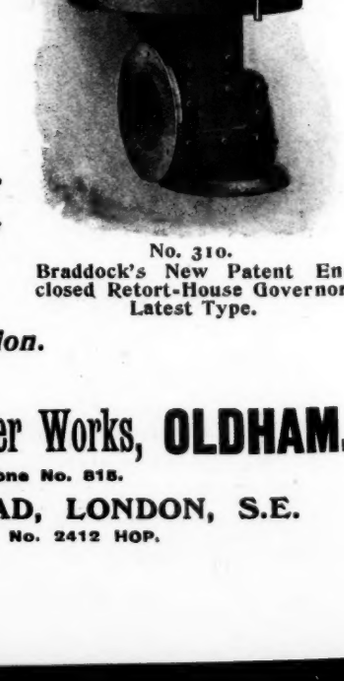

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## Torquay Gas Company.

The half-yearly meeting of the Company was held last Tuesday, when it was stated that during the past six months the sale of gas increased by nearly 2 million cubic feet, in spite of the restricted public lighting, earlier closing of business houses, and the request by the Government to adopt economy in the management of domestic affairs. The increase in receipts was £2263. The total receipts were £21,280, and the expenditure £18,036. The sum available for dividend was £10,197. The half-year's dividend amounted to £3230; and this left a balance to carry forward of £6966. The Directors saw no immediate necessity for further increasing the price of gas. Mr. R. Beynon (the Manager) and Mr. J. Duckworth (the Accountant) were congratulated on having completed 30 and 21 years service respectively with the Company. The usual dividends of 10 and 7 per cent. were declared.

Notice of motion has been given by Mr. T. Rogers at the Trim (co. Meath) Urban Council for letting the gas-works, on the grounds that the Auditor's report showed they were not being worked on a satisfactory basis, and that a previous report indicated a considerable loss.

Todmorden was partly in darkness on Saturday night, owing to the electric light suddenly failing in the centre of the town—causing much confusion and inconvenience. The mishap occurred at the busiest time of the evening, when the streets were crowded with people.

The Metropolitan Water Board have accepted the offers of a number of firms to renew their contracts for a further period of six months to supply cast-iron pipes and irregular castings at 17s 6d. per ton advance in prices, except in the case of one concern that offered a 5 per cent. advance.

The Directors of Glover and Main, Limited, have declared an interim dividend at the rate of 5 per cent. per annum on both the preference and the ordinary share capital of the Company.

It is reported by the "Chemical Tade Journal" that during 1914 there was produced in Italy 4000 metric tons of sulphate of ammonia, valued at £46,600. The production during 1913 was 3784 metric tons, valued at £51,140.

We are asked to mention that, at their last meeting, the Directors of the Yorktown and Blackwater Gas Company appointed Mr. HENRY J. RANDALL as their "Engineer and Manager," instead of "Engineer and Works Manager" as heretofore.

A fire in the floor of the operating-box of a Bradford picture theatre, was stated to have been caused by the fusing of an electric cable. A number of films were destroyed; but fortunately the fire-proof character of the operating-box prevented the flames spreading to the remainder of the building.

## APPLICATIONS FOR LETTERS PATENT.

13,048.—BENTLEY, J. E., "Gas-governors." Sept. 13.
13,076.—BUCKLEY, C. A. M., and OLSSON, C. M. T., "Gas-producers." Sept. 13.
13,253.—WELLINGTON, S. N., "Discharging coke." Sept. 16.
13,254.—WELLINGTON, S. N., "Charging retorts." Sept. 16.
13,292.—SIMMANCE, J. F., "Automatically controlling processes which produce gas." Sept. 17.
13,300.—ROOTS, J. D., "Incandescent mantle lamps." Sept. 17.

## GAS COMPANIES IN THE STOCK EXCHANGE.

The Stock Exchange has had a quiet week, and a dull one too into the bargain. Of course, the chief thing in everybody's thoughts has been the Budget and how it will affect market values. An extraordinary and gratifying feature is the general approbation with which it has been received, formidable and far-reaching though it be. Holes are being, and will be, picked in it here and there—over half-penny postcards, for instance—but in the main it is a very big success. The Germans are bragging about their War Loan; but bearing in mind the curious German methods of obtaining "subscriptions" on paper, it is quite another question how much of it is "money." Our Budget will produce hard cash. Prices in the Stock Exchange markets last week were nearly all lower. The War Loan became easier by fine gradations. Home Rails were quite depressed for reasons public and notorious; and even munition and armament concerns had something of a set-back, though accounts to hand show that some of them are making very big war profits. Canadians were about the strongest line—splendid harvest prospects being confirmed. Americans were fair. The negotiations for the loan are believed to be going along nicely. Shipping concerns closed firm. It may be noted that the powers (referred to in our last issue) sought by the board of one company to enable them to reject undesirable transfers were granted at the shareholders' meeting. Business in the Gas Market was quiet and colourless, and the bargains marked were not suggestive of any change of tone. A few issues, not frequently dealt in, however, came into notice. The Money Market was not at all active, but indications pointed to increased firmness.

Bargains done for cash during the week were as follows: On Monday, Alliance and Dublin debenture 64½, 65. Continental Union preference 50, Gas Light ordinary 78½, 79; ditto debenture 62⅝, Primitiva debenture 65. On Tuesday, Gas Light ordinary 78½, 79, Primitiva 2½, ditto preference 3 17/32, South Metropolitan 77¼, 77⅜, South Suburban 85. On Wednesday, European 12½, 12⅝, San Paulo preference 8⅛, South Metropolitan 76½, Tottenham "B" 102½, Wimbledon 104½, 105. On Thursday, Gas Light ordinary 78¼, 78½, ditto preference 72⅝, 72⅞, ditto debenture 62½, 61⅛, Imperial Continental 59½, 60, 60¼, South Metropolitan 77¼, Tottenham "B" 102. On Friday, Continental Union preference 46, Gas Light ordinary 77½, 77⅝, 77⅞, ditto debenture 62, 62⅜, 61⅛, Imperial Continental 59⅜, Primitiva preference 3 5/16. The Exchange was closed on Saturday.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

### LOWEST AND HIGHEST PRICES OF BARGAINS DONE FOR CASH IN THE WEEK ENDING SEPT. 25.

| Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. July 30. | Yield on Highest Closing Price. | Lowest and Highest Prices of Bargains. |
|---|---|---|---|---|---|---|---|
| £ | | | p.c. | | £ s. d. | | |
| 1,551,868 | Stk. | April 8 | 2½ | Alliance & Dublin Ord. | 59—64 | 3 18 2 | .. |
| 874,000 | ,, | July 10 | 4 | Do. 4 p.c. Deb. | 76—79 | 5 1 3 | 64½—65 |
| 280,000 | 5 | April 29 | 7½ | Bombay, Ltd. | 5½—6⅜ | 5 17 8 | .. |
| 50,000 | 10 | Feb. 26 | 16 | 10 p.c. | 29—30 | 5 6 8 | .. |
| 278,480 | 10 | ,, | 7 | Bournemouth Gas and Water { B 7 p.c. | 15—15½ | 4 10 4 | .. |
| 95,000 | 10 | ,, | 8 | Pref. 6 p.c. | 13½—14 | 4 5 9 | .. |
| — | — | — | — | Deb. | .. — | | .. |
| 880,000 | Stk. | Feb. 26 | 14 | Brentford Consolidated | 261—266 | 5 5 3 | .. |
| 330,000 | ,, | ,, | 11 | Do. New | 204—209 | 5 5 3 | .. |
| 50,000 | ,, | ,, | 5 | Do. 5 p.c. Pref. | 109—111 | 4 10 1 | .. |
| 206,250 | ,, | June 11 | 4 | Do. 4 p.c. Deb. | 91—93 | 4 6 0 | .. |
| 217,380 | Stk. | Feb. 26 | 11 | Brighton & Hove Orig. | 208—213 | 5 3 4 | .. |
| 244,200 | ,, | ,, | 8 | Do. A Ord. Stk. | 154—159 | 5 0 8 | .. |
| 530,000 | 20 | Mar. 26 | 12½ | British | 44—45 | 5 11 1 | .. |
| 120,000 | Stk. | June 26 | 4 | Do. 4 p.c. Deb. Stk. | 88—90 | 4 8 11 | .. |
| 245,771 | Stk. | June 26 | 4 | Buenos Ayres 4 p.c. Deb. | 85—87 | 4 12 0 | .. |
| 100,000 | 10 | — | — | Cape Town & Dis., Ltd. | 1½—2½ | — | .. |
| 100,000 | 10 | — | — | Do. 4½ p.c. Pref. | 4—6 | — | .. |
| 100,000 | Stk. | June 26 | 4½ | Do. 4½ p.c. Deb. Stk. | 70—75 | 6 0 0 | .. |
| 157,150 | Stk. | Feb. 26 | 5 | Chester 5 p.c. Ord. | 108—110 | 4 10 11 | .. |
| 1,518,280 | Stk. | Feb. 12 | 5/9/4 | Commercial 4 p.c. Stk. | 106—108 | 5 1 3 | .. |
| 660,000 | ,, | ,, | 5½ | Do. 3½ p.c. do. | 103—105 | 5 1 6 | .. |
| 475,000 | ,, | June 11 | 8 | Do. 3 p.c. Deb. Stk. | 69½—71½ | 4 8 11 | .. |
| 800 000 | Stk. | ,, | 4 | Continental Union, Ltd. | 76—79 | 5 1 3 | .. |
| 200 000 | ,, | ,, | 7 | Do. 7 p.c. Pref. | 115—118 | 5 18 8 | 46—50 |
| — | — | — | — | Croydon B and C 7 p.c. | .. — | — | .. |
| 492,270 | Stk. | — | 6 | Derby Con. Stk. | 128—135 | 4 16 0 | .. |
| 55,000 | ,, | — | 4 | Do. Deb. Stk. | 102—104 | 3 16 11 | .. |
| 1,002,180 | 10 | July 29 | 10 | European, Ltd. | 17½—18 | 5 11 1 | 12½—12¾ |
| 16,362,910 | Stk. | Feb. 12 | 4/17/4 | Gas Light and Coke { 4 p.c. Ord. | 98—102 | 4 15 6 | 77⅛—79 |
| 2,600,000 | ,, | ,, | 3½ | 3½ p.c. max. | 76—79 | 4 8 7 | .. |
| 4,062,235 | ,, | ,, | 4 | 4 p.c. Con. Pref. | 96—99 | 4 0 10 | 72⅝—72¾ |
| 4,674,850 | ,, | June 11 | 8 | 3 p.c. Con. Deb. | 72½—74½ | 4 0 6 | 62—62⅞ |
| 180,000 | ,, | ,, | 10 | 10 p.c. Bonds | .. — | — | .. |
| 258,740 | Stk. | Mar. 12 | 5 | Hastings & St. L. 3½ p.c. | 87—89 | 5 12 4 | .. |
| 70,000 | 10 | April 29 | 11 | Hongkong & China, Ltd. | 16½—16¾ | 6 11 4 | .. |
| — | — | — | — | Hornsey 7 p.c. | .. — | — | .. |
| 181,000 | Stk. | Mar. 12 | 7¾† | Ilford A and C | 151—154 | 5 2 4 | .. |
| 65,790 | ,, | ,, | 6¾† | Do. B | 115—118 | 5 8 0 | .. |
| 65,500 | ,, | June 26 | 4 | Do. 4 p.c. Deb. | 92—94 | 4 5 1 | .. |
| 4,940,000 | Stk. | May 14 | 9 | Imperial Continental | 150—160 | 5 12 6 | 59⅛—60½ |
| 1,235,000 | Stk. | Feb. 12 | 3½ | Do. 3½ p.c. Deb. Red. | 84—86 | 4 1 5 | .. |
| 200,342 | Stk. | Mar. 12 | 6½ | Lea Bridge Ord. 5 p.c. | 119—121 | 5 7 6 | .. |
| 561,000 | Stk. | Feb. 26 | 10 | Liverpool 5 p.c. Ord. { A | 211—213 | 4 13 11 | .. |
| 718,100 | ,, | ,, | 7 | | B 146—14 | 4 14 7 | .. |
| 306,083 | ,, | June 26 | 4 | Do. 4 p.c. Pr. Deb. Stk. | .. — | — | .. |

| Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. July 30. | Yield on Highest Closing Price. | Lowest and Highest Prices of Bargains. |
|---|---|---|---|---|---|---|---|
| £ | | | p.c. | | £ s. d. | | |
| 75,000 | 5 | June 11 | 6 | Malta & Mediterranean | 4⅛—4⅜ | 6 9 9 | .. |
| 250,000 | 100 | April 1 | 4½ | Met. of Melbourne { 4½ p.c. Deb. | 99—101 | 4 9 1 | .. |
| 541,930 | 20 | May 28 | 4 | Monte Video, Ltd. | 11½—12 | 6 18 4 | .. |
| 1,775,892 | Stk. | July 29 | 4½ | Newc'tle&G'tesh'd Con. | 98½—99½ | 4 10 6 | .. |
| 539,705 | Stk. | June 26 | 3½ | Do. 3½ p.c. Deb. | 82—83 | 4 4 10 | .. |
| 55,940 | 10 | Feb. 26 | 7/14/0 | North Middlesex 7 p.c. | 14—15 | 5 2 8 | .. |
| 300,000 | Stk. | May 14 | 8 | Oriental, Ltd. | 117—122 | 6 11 2 | .. |
| 60,000 | 5 | Mar. 26 | 10 | Ottoman, Ltd. | 7½—7⅝ | 6 9 0 | .. |
| 60,000 | 50 | Feb. 26 | 13 | Portsea, Island B | 128—131 | 4 19 3 | .. |
| 100,000 | 50 | ,, | 12 | Do. C | 118—121 | 4 19 9 | .. |
| 52,000 | 50 | ,, | 10 | Do. D | .. — | — | .. |
| 249,980 | 5 | April 29 | 8 | Primitiva Ord. | 5½—6 | 6 18 4 | 2½ |
| 499,960 | 5 | June 26 | 5 | ,, 5 p.c. Pref. | 4⅝—5 | 5 0 0 | 8/32—9 17/32 |
| 521,600 | 100 | June 2 | 4 | ,, 4 p.c. Deb. | 91—98 | 4 6 0 | 65 |
| — | — | — | — | ,, ,, 1911 | .. — | — | .. |
| 346,198 | Stk. | June 26 | 4 | River Plate 4 p.c. Deb. | 85—87 | 4 12 0 | .. |
| 150,000 | 10 | May 14 | 6 | San Paulo { 6 p.c. Pref | 10½—11 | 5 9 1 | 8⅞ |
| 125,000 | 50 | July 1 | 5 | 5 p.c. Deb. | 47—49 | 5 2 0 | .. |
| 135,000 | Stk. | Mar. 12 | 10 | Sheffield A | 293—294 | 4 9 8 | .. |
| 209,984 | ,, | ,, | 10 | Do. B | 292—294 | 4 9 8 | .. |
| 523,500 | ,, | ,, | 10 | Do. C | 290—293 | 4 10 1 | .. |
| 90,000 | 10 | May 28 | 9 | South African | 10¾—11½ | 7 16 6 | .. |
| 6,429,895 | Stk. | Feb. 12 | 5/4/0 | South Met., 4 p.c. Ord. | 111—113 | 4 16 8 | 76½—77¾ |
| 1,895,445 | ,, | July 10 | 3 | Do. 3 p.c. Deb. | 73¼—74½ | 4 0 6 | .. |
| 209,820 | Stk. | Feb. 26 | 8½ | South Shields Con. Stk. | 157—159 | 5 6 11 | .. |
| 952,795 | Stk. | Feb. 26 | 6 | S'th Suburb'n Ord. 5 p.c. | 114—116 | 5 8 1 | 85 |
| 60,000 | ,, | ,, | 5 | Do. 5 p.c. Pref. | 110—112 | 4 9 8 | .. |
| — | — | — | — | Do. West Kent. | .. — | — | .. |
| 137,058 | ,, | June 26 | 5 | Do. 5 p.c. Deb. Stk. | 116—118 | 4 4 9 | .. |
| 628,740 | Stk. | May 14 | 5 | Southampton Ord. | 99—102 | 4 12 0 | .. |
| 120,000 | Stk. | Feb. 12 | 7½† | Tottenham District { A 5 p.c. | 135—138 | 5 8 8 | .. |
| 742,275 | ,, | ,, | 6† | B 3½ p.c. | 115—117 | 5 2 7 | 102—109½ |
| 181,255 | ,, | June 26 | 4 | 4 p.c. Deb. | 87—89 | 4 9 11 | .. |
| 182,380 | 10 | Dec. 30 | 5 | Tuscan, Ltd. | 5—6 | 8 6 8 | .. |
| 149,900 | 10 | July 1 | 5 | Do. 5 p.c. Deb. Red. | 93—95 | 5 5 8 | .. |
| 236,476 | Stk. | Mar. 12 | 5 | Tynemouth, 5 p.c. max. | 108½—109½ | 4 11 4 | .. |
| | | | | Wandsworth, Wimbledon, and Epsom— | | | |
| 80,000 | Stk. | Feb. 26 | 8⅜ | Wandsworth A 5 p.c. | 151—156 | 5 7 4 | .. |
| 255,686 | ,, | ,, | 6⅜ | ,, B 3½ p.c. | 129—134 | 5 2 7 | .. |
| 108,075 | ,, | ,, | 5/17/8 | ,, C 3½ p.c. | 110—115 | 5 2 0 | .. |
| 859,000 | ,, | ,, | 6½ | Wimbledon 5 p.c. | 117—122 | 5 0 5 | 104½—105 |
| 98,000 | ,, | ,, | 6½ | Epsom 5 p.c. | 121—126 | 5 5 2 | .. |
| 88,416 | ,, | June 26 | 3 | 3 p.c. Deb. Stk. | 66—69 | 4 6 11 | .. |

* Ex Div.

## WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

**Appointments, &c., Vacant.**

SUPERINTENDENT. Sheffield Gaslight Company. Applications by Oct. 13.

ASSISTANT ENGINEER. Sheffield Water Department. Applications by Oct. 22.

GAS MANAGER. Llandudno Urban District Council. Applications by Oct. 11.

CHEMIST. No. 6100.

CARBONIZING FOREMAN. No. 6098.

WORKING FOREMAN. Abertillery Gas Department.

JUNIOR DRAUGHTSMAN. No. 6097.

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STOKERS. No. 6099.

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REPRESENTATIVE. Charrière, Paris.

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